

FAA ATO



EASTERN SERVICE AREA CHILLER REPLACEMENT

ILM – Wilmington International Airport

March 2012

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SECTION 01 10 10 - SUMMARY OF WORK – CHILLER REPLACEMENT

PART 1 - GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- A. These documents cover the requirements of the Federal Aviation Administration (FAA) for the replacement of a chiller that serves the Air Traffic Control Tower located at the Wilmington/Hanover International Airport. The airport is located at 2220 Control Tower Drive, Wilmington, NC 28405. The FAA intends to award a firm fixed price construction contract to fulfill this requirement.
- B. All products, materials, accessories etc. shall be the standard cataloged product of a company regularly engaged in the manufacture of said products, materials, accessories, etc. for chillers for a period of not less than 5 consecutive years. Each product, material, accessory etc. shall have been in successful service for a period of at least 2 years without modification or redesign.
- C. The Contractor shall inform each equipment supplier, vendor, and technical representative of the nature of the structure that these products, materials, accessories etc. will be installed. Specifically, any supplier or representative shall be given the physical size of the concrete pad and clearances available on-site and any other data that might affect the selection of products, materials, accessories, etc.
- D. The Contractor shall have a permanent address, telephone number and shall have been in continual business of replacing and installing chillers for not less than 3 years. The Contractor shall be duly licensed to perform chiller replacement in the state where the chiller is located. The Contractor shall be a member in good standing with the General or Mechanical Contractors Association.
- E. Project Description:
 - 1. The work shall include furnishing all labor, materials, equipment, and services as necessary to install a temporary chiller and replace the existing chiller with minimal service outage. The successful Contractor shall be responsible for all aspects of the installation of a temporary chiller and replacement of the existing chiller in these Specifications, including any electrical, mechanical, architectural, control interface, security, communications and structural work associated with the installation of a temporary chiller and replacement of the existing chiller. Refer to the paragraph 1.10 B. below for more requirements on schedule of the project.
 - 2. As part of the proposal, the Contractor shall provide a complete and comprehensive schedule to the Contracting Officer (CO) for review and evaluation. Upon contract award, the tendered Schedule will become a material term of contract performance. The Schedule shall outline all phases of the work and the impact on the operation of the facility. The tendered Schedule will be a factor evaluated by the FAA in making a decision for contract award.
 - 3. Where “submittal required” is indicated below or herein these Specifications, the

Contractor shall submit, after award of the contract, the manufacturers' detailed technical information for FAA review, acceptance, or approval. Note that some submittals are required to accompany the proposal as noted.

4. Also required is a detailed description of the proposed technical means of performing the specified task within the firm fixed price of the executed contract.

1.2 BASIC METHODS AND MATERIALS

- A. The Contractor shall submit product information, including MSDS sheets, for FAA approval regarding the methods and materials specified hereinafter. Note that some submittals are required to accompany the proposal as noted.

- B. General:

1. Use of any of the substances or performing any of the operations specified herein shall be conducted only in areas with adequate ventilation. The contractor shall provide temporary portable ventilation equipment as required to exhaust any fumes, gases, particulates, etc. generated by the use of the subject substances or performing the processes specified herein. The ventilation system shall discharge the byproducts to a safe location outside the facility.
2. Workers that are using the substances or performing the operations specified herein shall use Personal Protective Equipment (PPE) as required by FAA, OSHA, EOSH or other authority having jurisdiction.

- C. Soldering And Welding:

1. Solder shall be a lead free type for any work on piping systems that convey liquids or gases. Solder for electrical/electronic connections shall also be lead free, and shall be the rosin core type unless a different type of solder or a different procedure is specifically called for by the manufacturer of the pieces to be joined. Mechanically clean all the surfaces to be soldered. Submittal and approval of materials and methods is specifically required.
2. Welding shall be performed outside the facility to the maximum extent possible. Welds that cannot be accomplished outside the facility shall be done during periods, as determined by the Resident Engineer (RE), that present the minimum possible exposure to FAA personnel and possibilities of disrupting the operations within the facility, typically at night.
3. Note that prior to performing any welding, cutting, or brazing activities, a Hot Work Permit will be required. Before conducting any of these activities, either inside or outside the building, contact the RE to obtain the permit. At least 48 hours notice shall be given as to not delay work. Soldering with electrically heated soldering irons or guns does not require this permit.

- D. Painting, Cleaning, Gluing And Use Of Other Chemicals:

1. The contractor shall submit MSDS sheets for FAA review and approval before using any of the subject substances. These substances shall be, to the maximum extent possible, volatile organic compound (VOC) free or at least very low in VOC's. If products containing VOC's are used, the contractor shall monitor the area with appropriate instruments to ensure that the presence of VOC's does not exceed recommended minimum threshold levels. Supplementary ventilation shall be used as specified above.

- 1.3 All of the subject substances shall be, to the maximum extent possible, "Green", that are biodegradable type substances. If the required substances are not biodegradable, they shall be disposed of in an approved manner in accordance with all federal, state and local codes for hazardous materials.

1.4 SAFETY

- A. A fall protection and safety equipment installation plan shall be coordinated with the FAA Resident Engineer and in compliance with the latest OSHA standards. A fall protection plan shall be submitted to the SSC Contact and RE before starting work.

1.5 AVAILABILITY OF UTILITIES AND STORAGE

- A. Water, electricity and sanitary facilities are available for the Contractor's use. Public telephone service is not available. Storage space for materials and equipment is limited on the site. The Contractor shall provide storage for all materials and shall limit on-site storage to no more than two parking spaces.

1.6 CONTRACT METHOD

- A. Construct the Work under a single lump sum contract.

1.7 BID EVALUATION CRITERIA

- A. The following evaluation criteria will be used by FAA in determining the successful bidder. Price alone will not be the only determining factor. All items are weighted the same unless stated otherwise.
1. Furnish a comprehensive schedule of the work, including the total time to complete the project.
 2. Furnish with the proposal a list of the manufacturers and product data for the equipment requiring submittals. Sufficient detail should be included to determine compliance with the Plans, Specifications and Appendices. Detailed submittals will be required by the successful contractor.
 3. Furnish with the proposal a list of proposed sub-contractors with a list of projects that they were a sub-contractor to the bidder on similar chiller replacement projects.
 4. Furnish with the proposal the years of experience in the replacement of chillers by the company owner and foremen that will be working on this project.
 5. Furnish with the proposal the number of years the company has been in the chiller replacement business.
 6. Furnish with the proposal a list of three (3) references with contact information.
 7. Price.

1.8 SITE VISIT

- A. A site visit by interested Contractors is required. Interested contractors may make arrangements by coordinating with the Contracting Officer. The site is located at the Wilmington/Hanover International Airport at 2220 Control Tower Drive, Wilmington, NC 28405.

1.9 PERFORMANCE TIME

- A. The Contractor shall complete the replacement of the chiller within the calendar days agreed to after Notice To Proceed. Performance time shall include the Test Period specified herein. The time required for the FAA to review, comment and approve the submittals, and equipment ordering lead-time will be included in the Contractor's performance time. Notice To Proceed with the construction phase will not be granted until the Contractor certifies to the CO that all required materials and equipment, as approved by the FAA, are in his possession and ready for installation.

1.10 WORK SEQUENCE

- A. Construction Work stages shall be defined by the Contractor. Additional phasing may be necessary due to site availability restrictions. Portions of Stages may be simultaneous.
- B. Schedule of Work
 - 1. The Contractor shall provide a complete and comprehensive schedule as part of its technical proposal at the time of submitting a proposal. The Schedule shall outline all phases of the work and their impact on the operation of the chilled water system. Overtime work, extended work on weekends and double shifts shall be included as part of the proposal as necessary to accomplish the replacement in the shortest time possible. All work that does not require an outage shall be performed during normal daytime hours from 7:30 AM to 4:00 PM unless otherwise scheduled in advance and approved by the CO or COTR. Outages shall be held to a minimum number and a minimum of time.
 - 2. It should be noted that the chiller is the main source of cooling of personnel and sensitive electronic equipment in the ATCT, which is essential to the operation of the air traffic at the airport and therefore the National Air Space (NAS).
 - 3. Any operations that will require the temporary chiller, new chiller or existing chiller to be out of service shall be accomplished between the hours of 2300 hours and 0600 hours.

1.11 CONTRACTOR USE OF PREMISES

- A. The FAA shall have the right of unlimited access to the premises.
- B. The FAA or other agencies may be constructing other improvements during a portion or all of this construction. This Contractor shall coordinate with any such contractors.
- C. Coordinate use of premises in accordance with the site availability shown on the plans and as directed by the RE.
- D. Assume full responsibility for protection and safekeeping of project materials under this

Contract.

- E. Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- F. Parking is not allowed along existing roads or within portions of the site used for active FAA operations.

1.12 ACCESS TO SITE

- A. Contractor's access to site shall be as shown on the plans, if issued, or as directed by the RE. The Contractor shall not permit any unauthorized construction personnel or traffic on the site. The Contractor shall be responsible for traffic control to and from the various construction areas on the site. Directional signing at the access gate and along the delivery route to the storage area or work site shall be as directed by the RE. The Contractor will not be allowed to close any traffic lanes nor will the Contractor be allowed to impede the flow of airport traffic.

1.13 DEMOLITION

- A. Any equipment obstructing the Contractor's access to the work area shall either be temporarily relocated by the Contractor to a storage area designated by the RE or be covered in a manner as to provide suitable access while protecting the Government property from construction damage. At the completion of all work, the Contractor shall return all such items to their original location.
- B. Any unused conduit, wire, equipment, structural supports or other fittings associated with equipment or devices to be removed under this contract shall be disposed of by the Contractor within the firm fixed price of the contract.
- C. Removal of refrigerant from existing chiller at site shall be documented and disposed of by proper means.
- D. Remove unused structural support angles, channels, bolts, and similar hardware. Patch any holes resulting from removed equipment, hardware, conduit or pipe with the same material as that of the penetrated surface (i.e.: concrete floor openings shall be filled with concrete). Paint and patch to match adjacent undisturbed surface. Fire barriers shall be patched with U.L. rated assemblies.
- E. Any equipment or material to be removed, unless specified to remain the property of the FAA, shall become the property of the Contractor and shall be transported from the site and disposed of in a legal manner.

1.14 MATERIALS DELIVERY TO THE SITE

- A. All material orders for delivery to the site shall use the site delivery address. Delivery trucks shall not pass in front of the terminal, if at all possible, and then only with prior notification and the written approval of the Airport Authority.
- B. Normal flow of traffic, into and out of the facility, shall not be impeded. Deliveries can be

suspended at the direction of the RE, for any reason, if these requirements are not met.

- C. The Contractor is responsible for immediate clean-up of any debris deposited along the access road as a result of their construction traffic.

1.15 SECURITY REQUIREMENTS

- A. Personnel List: Contractor shall provide the Resident Engineer with a list of Contractor's personnel who will require access to the site. The list shall be kept current during project work. The Contractor shall provide all personnel with readily identifiable numbered badges during the period their access to the site is required. Badges shall be in accordance with FAA Facility Requirements and shall be worn on outer clothes at all times when on FAA property and at work in the site.
- B. Right to Search: Current procedures at FAA facilities located within the FAA property boundaries include the "right to search". If in the judgment of the authorized security guard a cause to search a vehicle or the person of personnel exists, such search will be made.

1.16 CONSTRUCTION AREA LIMITS

- A. The limits of construction material storage areas, equipment storage areas, parking areas, and other areas as required by the Contractor shall be as approved by the RE. Should the Contractor find it necessary or advantageous to use any additional offsite area for any purpose whatsoever, Contractor shall, at its expense, provide and make its own arrangements for the use of such additional offsite areas.
- B. Employee Parking. Parking will not be allowed along public right of way or the entrance/exit road. In the event adequate space is not available for parking on the project site the Contractor shall arrange for off-site parking and provide transportation of employees to and from the site. No other areas will be made available for Contractor use for parking, staging, trailers, or storage.

1.17 FAA RETAINED EQUIPMENT AND MATERIALS

- A. There is no FAA retained equipment.

1.18 TEST PERIOD AND FINAL CHECKOUT

- 1.19 The Contractor shall include in the project schedule a test period of not less than 7 days of continuous operation without a fault or interruption in the chiller's performance. If the chiller should experience a problem, the entire test period shall begin again after the problem has been diagnosed and corrected. The temporary chiller shall remain on-site until a successful 7 days of testing has been completed.

- 1.20 The contractor shall provide continuous monitoring during the test period by a technician

knowledgeable and capable of placing the chiller back in service should a fault or other incident take it out of service. The continuous monitoring shall be for 7 calendar days during normal operating hours of the facility, without a fault or other incident, during any hours, (0600 to 2300 hours for this project) that the ATCT or facility is occupied by FAA personnel during their normal shift hours.

1.21 PERMITS AND FEES

- A. Contractor is responsible for applying for and obtaining required permits, and payment for any associated fees. Compliance is required with the conditions of all permits that have been issued. All fees must be paid by the Contractor.
- B. Contractor is responsible for paying all charges associated with the construction of the project. This includes temporary permits, re-inspection fees, connection fees and equipment to be installed by third parties.

1.22 SUBMITTALS

- A. See Specification 01 33 00.

1.23 PLANS AND SPECIFICATIONS

- A. In the event of any conflicts, ambiguities or discrepancies among the Contract Documents, the precedence in resolving such conflicts, ambiguities, or discrepancies shall be as follows:
 - 1. The Schedule of Bid Items (excluding the specifications)
 - 2. Representations and other instructions
 - 3. Contract Clauses
 - 4. Contract modifications
 - 5. Addenda
 - 6. Special Provisions shall govern over General Conditions, Division 1, and Technical Specifications.
 - 7. General Conditions shall govern over Division 1, Technical Specifications, and Plans.
 - 8. Division 1 shall govern over Technical Specifications and Plans.
 - 9. Technical Specifications shall govern over Plans and over Standard Specifications and over standards for testing and materials. Drawings take precedence over specifications as to quantity and location. Specifications take precedence over Drawings as to quality of materials and workmanship.
 - 10. Plans shall govern over Standard Specifications and over standards for testing and materials.
 - 11. On the Plans, calculated or figured dimensions shall govern over scaled dimensions.
 - 12. Subject to the foregoing provisions of this paragraph, the more stringent requirements shall apply in the event any conflicts cannot be resolved by applying the order of precedence.
- B. Plans shall be defined, for the purposes of this contract, FAA issued drawings, shop drawings,

submittal drawings or other drawings issued specifically for the installation of any components.

1.24 INSTRUCTION OR OPERATION AND MAINTENANCE MANUALS

- A. Upon completion of work, the Contractor shall submit to the RE four (4) bound copies of an instruction manual (also referred to as an Operation & Maintenance Manual). This manual shall contain, but not be limited to, instructions for installation, operation and maintenance, replacement parts list, sequence of operation description, sizing and capacity data and manufacturer's guarantee information for all equipment furnished by the Contractor. An electronic version, or Portable Document File (PDF), shall be provided as well.

1.25 TRAINING

- A. Contractor shall provide a factory approved 4 hour training class for four (4) FAA personnel. Contractor shall provide a training sign-in attendance list to the FAA Resident Engineer. O & M manuals shall be delivered prior to this training and shall be included in the training.
- B. At a minimum, the FAA personnel shall be instructed on how to reset the chiller in the event of an automatic shutdown, preventive maintenance procedures and how to troubleshoot the system.

1.26 WARRANTIES

- A. The Contractor shall warrant all materials, equipment and labor for all work performed under this contract. This warranty shall be for a period of two (2) calendar years beginning upon the date of contract acceptance inspection (CAI). The warranty shall be unconditional and the Contractor shall furnish all labor, refrigerant and materials required to repair or replace defective or failed portions of the contract work. The warranty requires coverage 24 hours-a-day seven (7) days a week. Additional overtime charges are not applicable to this part of the project.
- B. In addition to the warranty, the Contractor shall provide a proposal for an extended parts, labor and refrigerant warrantee for an addition three (3) calendar years beyond the warrantee specified in paragraph A. The Contractor shall also provide a proposal for an extended parts, labor and refrigerant warrantee for an additional eight (8) years beyond the warrantee specified in paragraph A. The Contractor shall respond within 1.5 hours of notification of a chiller service interruption by the FAA.
- C. The Contractor shall furnish to the Resident Engineer (RE) the manufacturer's certificate of this warranty stating the beginning and ending dates of the period of coverage. Also, guarantee that each piece of apparatus shall have a capacity or performance of not less than that specified when the apparatus is operating under specified design conditions.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

PART 4 – EVALUATION FACTORS FOR AWARD

- A. The Government will award a single contract resulting from this Screening Information Request (SIR) to the responsible offeror whose offer submitted in response to, and conforming with, this SIR is determined to represent the **BEST VALUE TO THE GOVERNMENT** considering price and other factors as listed below. Award shall not be based on price alone. The Government may be willing to pay a higher price for a higher-rated contractor.
- B. The Government may:
1. Reject any or all offers if such action is in the public interest;
 2. Accept other than the lowest offer;
 3. Waive informalities and minor irregularities in offers received;
 4. Make award without written or oral discussion with offerors.
 5. Have discussions with any one offeror, all offerors, or without any discussion.
- C. In addition to price, award will be based on best value to FAA considering the following factors which are listed in relative order of importance:
1. Past Experience (40% weight). The contractor shall demonstrate past experience in performing similar work. Prior past performance and experience working in FAA facilities will be given added consideration. Also, if your firm does not demonstrate that it has acceptable past experience, then the FAA reserves the right to discontinue further evaluation of the other criteria for that particular firm.
 2. Ability to Meet the Contract Requirements in Terms of Other Commitments and Availability of Resources and Equipment to Perform the Work (30% weight). The FAA will consider the contractor's ability to handle the projects based on existing contract work, and availability of personnel and equipment to perform the work. If the Contractor bids on multiple FAA projects under this solicitation they must be able to execute the projects simultaneously.
 3. Past Performance, Business Practices and Customer Satisfaction (20% weight). This factor includes, but is not limited to, maintenance of good customer relations and motivation to perform well, ability to work effectively with owner, cooperation in solving price increases or proposing credits, timeliness of payments to subcontractors, and promptness, completeness, and accuracy of written submissions. The government may consider any other verifiable outside information known or learned about the offeror, such as another office's experience with the offeror, or personal knowledge of the offeror's prior performance.
 4. Financial Condition (10% weight). Submit copies of financial statements, Dun & Bradstreet reports, or other data you choose, sufficient to enable the Government to evaluate your firm's financial condition and responsibility. Submit bond capacity for an individual project and total aggregate bond capacity.

END OF SECTION 01 10 10

SECTION 01 10 12 - CONSTRUCTION ADMINISTRATION FORMS

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. The attached forms are hereby made a part of the Construction Documents.

PART 2 - PRODUCT

2.1 INDEX OF CONSTRUCTION ADMINISTRATION FORMS FOR CONTRACTOR

RFI Standard Form
Submittal Approval Form
FAA Pre-Construction and Maintenance Project Safety and Health Checklist
Job Memorandum (JM)
Hot Work Permit

PART 3 - EXECUTION

- 3.1 During the administration of the Contract, the Contractor will be required to complete various construction administration forms as a part of the Management System. These forms are identified above and will be issued at the Pre-Construction Conference. These forms may be revised during the construction period and the Contractor will be required to comply with any such revisions.

END OF SECTION 01 10 12

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Federal Aviation Administration

Request For Information
No. 000

Title: _____

From:	Project:	To:
Contractor	JOB TITLE	
Contractor address	Job Location	
	Contract:	Phone:
Phone:		Fax:
Fax:		RE:
Contact:		
Drawing or Spec:	Date Started:	Priority: Normal
	Date Required:	Potential Cost Impact? <input type="checkbox"/> Yes <input type="checkbox"/> No
Attachments? No	Date Completed:	Potential Schedule Impact? <input type="checkbox"/> Yes <input type="checkbox"/> No
		If yes to either, explain below.

Question (Include Potential Impacts):

Response:

By: _____, FAA

Date:

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APPROVAL OR DISAPPROVAL OF CONTRACTOR'S MATERIALS OR SHOP DRAWINGS				DEPARTMENT OF TRANSPORTATION FEDERAL AID ADMINISTRATION			
1. TO: Contractor Address Tel: Fax: ATTN:				2. DATE CONTRACTOR'S SUBMITTAL RECEIVED:		3. DATE SUBMITTAL RETURNED:	
				4. GOVT TRANS. NO.		5. CONTRACTOR'S TRANS. NO.	
				6. PROJECT NAME			
				7. CONTRACT NUMBER			
8. TRANSMITTAL REFERENCE TO CONTRACT DRAWINGS and/or SHOP DRAWINGS							
9. TRANSMITTAL REFERENCE TO CONTRACT DRAWINGS AND PARAGRAPH NUMBER and/or CHANGE ORDER NUMBER							
10. FACTS: Gentlemen: We are returning herewith the following Submittal Data:							
A. ITEM NO.	B. NO. COPIES	C. NAME OF SUPPLIER	D. TYPE OF MATERIAL OR EQUIPMENT	E. APPROVAL		F.	
				AS SUBMITTED	AS NOTED*	NOT APPROVED †	REVISE AND RESUBMIT
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G. REMARKS							
H. STIPULATIONS							
*Data marked "Approved as Noted" is satisfactory, contingent upon contractor acceptance of corrections and/or notations, and if accepted does not require re-submittal.							
†Data marked "Not Approved" does not meet job requirements, and contractor must re-submit on proper basis.							
Approval of Data does not obviate Contractor Responsibility for correct take-off or installation clearance.							
Carbon Copies Transmitted To:				Sincerely,			
_____				_____			
_____				Resident Engineer			

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FAA PRE-CONSTRUCTION AND MAINTENANCE PROJECT SAFETY AND HEALTH CHECKLIST

Purpose

This checklist is intended to be used as a tool by RE/COTR's, designated facility POC's, or SSC managers who oversee construction and maintenance activities that potentially have Occupational Safety, Health, and Environmental (OSH/E) related impacts on AT/AF operations. This tool shall be used, as appropriate, during critical phases of construction and maintenance activities (e.g. the pre-construction meeting, 30-60 days prior to commencement of work, weekly/daily construction meetings, etc.). Emphasis should be placed on using this checklist as a tool to assess as well as reassess hazards as the project progresses. Specifically, this checklist is intended to:

- Promote sensitivity to potential OSH/E hazards associated with projects and stress the importance of not disrupting NAS operations
- Assist in identifying and validating potential project hazards and associated risks
- Assist in preventing safety and health incidents/accidents and facility shutdowns
- Ensure appropriate contractor measures and controls are in place to address potential project hazards
- Facilitate discussion with the contractor regarding plans to prevent/minimize potential incidents/accidents
- Enhance coordination between OSH/E professionals, project personnel and contractors
- Facilitate review of critical FAA OSH/E procedures with contractors
- Raise OSH/E awareness

- This checklist relies on the training and professional judgment of the user. OSH/E personnel should be consulted as needed.

- A facility POC with a thorough understanding of facility procedures and equipment considerations should participate in the site walk-through.

NOTE: For small procurements (e.g. credit card purchases) and internal FAA projects (e.g. field maintenance party projects), without specifications, immediately contact the designated OSH/E professional for assistance in completing this checklist.

1 Project Summary Information

Fill in the requested site-specific information.

Project Name, Description and Location: _____

Project/Activity/Task (detail): _____

Planned Start: _____

Expected Completion Date: _____

ANI/Contractor Contact: Name: _____

Phone: _____

OSH/E Contact: Name: _____

Phone: _____

Facility AF POC: Name: _____

Phone: _____

2 Facility Procedures

Review site specific FAA procedures and considerations with the contractor. For example, discuss when or how during the project, emergency plans will be used/required. After the procedures have been reviewed, perform a site walk-through with the contractor.

Facility Procedures	Reviewed?			Notes
	Yes	N/A	No	
Asbestos Contingency Plan	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Critical Power Systems Awareness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Lock Out/Tag Out	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Work Permits (e.g. Asbestos, Lead)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Emergency Plans (e.g. Occupant Emergency Plan)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Impacts to Fire Alarm and Suppression Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Site Walk-Through with Facility POC & Contractor(s)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Hazard Communications (e.g. MSDS's)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other (e.g. Access/Security/Communications Equip.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

2 Project Hazard/Risk Analysis

Review site specific FAA procedures and considerations with the contractor. For example, discuss when or how during the project, emergency plans will be used/required. After the procedures have been reviewed, perform a site walk-through with the contractor.

Potential Project Hazards (Consider Sensitive AT/AF Operations)	Level of Potential Risk For Exposure/Release/Incident			Notes
	High	Low	N/A	
Hazardous Substances and Env Controls				
Asbestos (e.g. Tiles & Insulation)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Chemical, Gas, Fumes, Dust, Radiation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Indoor Air	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Ventilation System	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Lead-based Paint	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical Power Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Pressurized Equipment Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Work at Heights (>6 feet)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other (e.g. Confined Space)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

4 Site Safety and Health

After reviewing the potential hazards and risks in block 3, ensure that the contractor has identified measures and controls to address applicable site safety and health risks (e.g. through discussions, available site safety plans, or other applicable documents). In your judgment, if the contractor has appropriate measures to address the potential project hazards (see block 3), check the appropriate YES boxes below. If a potential project hazard has been identified in block 3 and no associated measures or controls are evident, then check the appropriate NO boxes below. If a NO box is checked, use the closeout date box to indicate when appropriate measures or controls have been incorporated into the contractor's site safety and health approach.

Program Elements	Yes	N/A	No	Closeout Date	Notes
Hazardous Substances & Environmental Controls					
Asbestos	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Chemicals (e.g. Introduced to site) Provide MSDS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Gas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Fumes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Lead Paint/Other Coatings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Radiation and Electric Fields	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Ventilation and Exhaust Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Electrical Power Systems					
Procedures for Critical Power Systems Coordination	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Provisions for GFCI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Control of Hazardous Energy (lockout/tagout) (e.g. electrical, mechanical, hydraulic, thermal, radiation)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Pressurized Equipment and Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Work at Heights (>6 feet)					
Safe Access and Fall Protection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Work Platforms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Floor and Wall Holes and Openings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Personal Protective and Safety Equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Fire Prevention	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Accident Prevention	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Excavations (New Construction or Tie in)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Welding and Cutting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Demolition of Existing Facility in Whole or Part	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Medical and First Aid Requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Hand and Power Tools	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Material Handling, Storage, and Disposal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Rigging	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Machinery and Mechanized Equipment (e.g. Equipment & Operator Certifications)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Sanitation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Lighting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Concrete & Masonry Construction & Steel Erection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Hazardous, Toxic, Radioactive Waste Activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Other (e.g. Noise)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

5 Review Information

The appropriate FAA point of contact and the contractor shall sign below to document discussion of the items on this form.

Reviewed By:	Date
FAA POC: <u>See Addendum</u>	
Contractor: <u>See Addendum</u>	
Incident Prevention and Hazard Control Methods Discussed? <input type="checkbox"/> Yes <input type="checkbox"/> No	

This block indicates routing of this checklist for project coordination.

This form has been forwarded to:	Name	Date
SECM, OSH/E Contact:	<u>See Addendum</u>	
AF Facility Manager:	<u>See Addendum</u>	
AT Facility Manager:	<u>See Addendum</u>	
Other:	<u>See Addendum</u>	

Notes (e.g. provide further explanation of potential hazards, locations, etc. below and attach additional sheets if necessary.)

ANI Risk Mitigation Addendum**Communicate Your Activities**

Review the project construction or installation activities with emphasis on potential risks to unscheduled interruptions with the site AF POC. Provide plans to mitigate each of those risks and to restore operations should an unscheduled interruption occur. Have the AF POC and the AF site manager sign the check sheet indicating approval of the plans and fax to the ANI platform manager for approval BEFORE beginning work. Ensure that the AF POC coordinates with air traffic to keep them aware of installation activities. *Items marked with an asterisk require daily coordination with AF.*

Elements	Risk		Mitigation and Restoration Plan
	Yes	No	
Engineering Package			
Review of risk mitigation procedures and cut-over plans	<input type="checkbox"/>	<input type="checkbox"/>	
Airport Access and On-Airport Driving			
Badging	<input type="checkbox"/>	<input type="checkbox"/>	
Airport driver training	<input type="checkbox"/>	<input type="checkbox"/>	
Communication with ATCT	<input type="checkbox"/>	<input type="checkbox"/>	
Properly marked vehicle	<input type="checkbox"/>	<input type="checkbox"/>	
Access to Electrical Power			
* Essential power panels, risk of opening panel, installing conduit, manipulating wiring, etc.	<input type="checkbox"/>	<input type="checkbox"/>	Site tech shall supervise any work in power panels and energize/de-energize circuits.
* Critical power panels, risk of opening panel, installing conduit, manipulating wiring, etc.	<input type="checkbox"/>	<input type="checkbox"/>	Site tech shall supervise any work in power panels and energize/de-energize circuits.
Cable raceways	<input type="checkbox"/>	<input type="checkbox"/>	
Demarcs, Junction Boxes, Racks and Buried Cable			
Proper identification of cables and terminations	<input type="checkbox"/>	<input type="checkbox"/>	
Proximity of critical operational circuits	<input type="checkbox"/>	<input type="checkbox"/>	
* Coordination of digging activities	<input type="checkbox"/>	<input type="checkbox"/>	
Backup Systems			
Checkout of backup systems that may be required after unscheduled interruption (including diverse routes).	<input type="checkbox"/>	<input type="checkbox"/>	
Checkout of operational systems prior to modifications	<input type="checkbox"/>	<input type="checkbox"/>	
Access to Signal Cable Raceways			
Identify affected cable trays	<input type="checkbox"/>	<input type="checkbox"/>	
ATCT shaft	<input type="checkbox"/>	<input type="checkbox"/>	
* Operational consoles	<input type="checkbox"/>	<input type="checkbox"/>	
Removing unused cable	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment Releases			
Schedule	<input type="checkbox"/>	<input type="checkbox"/>	
Coordination with AF/AT	<input type="checkbox"/>	<input type="checkbox"/>	
Log entries	<input type="checkbox"/>	<input type="checkbox"/>	Review maint log entries ensuring purpose for release is included.
* Removal from service	<input type="checkbox"/>	<input type="checkbox"/>	Will ask site technician to remove equipment from service.
Work Outside of Normal Duty Hours			
Schedule of activities	<input type="checkbox"/>	<input type="checkbox"/>	
Coordination of OPS overtime handoff if required	<input type="checkbox"/>	<input type="checkbox"/>	
Unscheduled Interruptions			
Restoration	<input type="checkbox"/>	<input type="checkbox"/>	
Return to service	<input type="checkbox"/>	<input type="checkbox"/>	Site tech must return to service and make log entries.
Notifications	<input type="checkbox"/>	<input type="checkbox"/>	Site AF manager and platform manager shall be notified ASAP.
Contractors			
Badging	<input type="checkbox"/>	<input type="checkbox"/>	
Oversight	<input type="checkbox"/>	<input type="checkbox"/>	ANI/TSSC shall provide continuous oversight of all contractors.
Parking	<input type="checkbox"/>	<input type="checkbox"/>	

AF Site POC:

Date _____

AF Site Manager:

Date _____

ANI Site POC:

Date _____

ANI Platform Manager:

Date _____

Copies provided to Site AT, AFSMO (for SECM and OSH/E contact), and ANI Operations Liaison

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U.S. Department
of Transportation

Federal Aviation
Administration

ATLANTA TERMINAL ENGINEERING CENTER

P.O. Box 20636
Atlanta, Georgia 30320-0631

JOB MEMORANDUM (JM)

JM No.: _____ Date: _____ Sheet ____ of ____

To: _____

Project: _____ (B.P. _____)

Field inspection has indicated that the following work is not being performed in accordance with the Contract Documents. The Contractor is requested to provide his proposed Contractor Corrective Action (CCA) no later than _____.

Reference: Sheet No.: _____ Specification No.: _____ Other: _____

Subject: _____

Description _____ of _____ Discrepancy: _____

Resident Engineer _____

CONTRACTOR'S CORRECTIVE ACTION (CCA)

CCA No.: _____ Date: _____

To: **FEDERAL AVIATION ADMINISTRATION – RESIDENT ENGINEER**

The following action has been

taken _____

Contractor _____

FAA's

Response: _____

cc: FAA Contracting Officer, FAA Project Engineer, A/E

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HOT WORK PERMIT

(for welding, cutting, or brazing activities)

THIS FORM MUST BE COMPLETED IN ITS ENTIRETY BY THE RESPONSIBLE PERSON PERFORMING THE HOT WORK, OR THE RESIDENT ENGINEER OVERSEEING THE CONTRACTOR WHO IS PERFORMING THE HOT WORK.

Facility ID and Type: _____ Date: _____

Responsible Person: _____ Start Time: _____

Finish Time: _____

Work to be performed: _____ Building: _____

_____ Room Number, Area or Equipment: _____

Is it possible to perform this work in a welding shop or other type of workshop? Yes No

Complete the checklist below and if any of the tasks have not been completed, please provide, in the comments section the reasons for not completing the tasks and the precautionary measures that will be implemented.

<u>Task</u>	<u>Yes</u>	<u>No</u>	<u>Comments and/or Corrective Measures</u>
Flame or spark-producing equipment to be used has been inspected and found in good repair.			
Fire Alarm systems are operational and will not be taken out of service while welding, cutting, or brazing activities are performed. If necessary, the automatic smoke detectors in the immediate vicinity of the hot work may be temporarily disabled via functions at the fire alarm control panel or otherwise covered, and returned to operational immediately following the smoke producing activities associated with the hot work.			
Sprinklers, where provided, are operational and will not be taken out of service while this work is being done.			
There are no combustible fibers, dusts, vapors, gases or liquids in the area.			
The work will only be performed in the area specified on this permit.			
Surrounding floors have been swept clean and, if combustible, wet down.			
All floor and wall openings within 35 feet of the operations have been tightly covered.			
All combustibles have been relocated at least 35 feet from the operation. If no, then are barriers or guards used to contain the heat, sparks and slag. Protection should include metal guards or flame- proofed curtains, blankets, or covers (not ordinary tarpaulins (tarps)).			

<u>Task</u>	<u>Yes</u>	<u>No</u>	<u>Comments and/or Corrective Measures</u>
A "Fire Watch" will be posted in area of activity, prior to starting welding, cutting, and brazing activity, and will patrol the area, including floors above and below, during any lunch or rest period and for at least one-half hour after the work has been completed to ensure the sparks and slag have not started fires.			
If bystanders and/or fire watch may be exposed to UV or burn hazards they will be appropriately protected with PPE.			
Fire extinguisher available for instant use within 20 feet.			
Cutter/welder is trained in safe operation of equipment and the safe use of the process.			
On-site contractors were advised about flammable material or hazardous conditions of which they may not be aware.			
Welding or cutting on material containers that contain or did contain flammables: Container thoroughly cleaned and ventilated; Any pipe lines or connections to containers disconnected or blanked; and Approved by ROSHM or EOSH Coordinator.			
Personal Protective Equipment (PPE) used: Eye protection Helmets Protective clothing Other (Specify)			
Warning sign posted to warn of hot metal.			
Appropriate ventilation provided.			
When working in confined spaces a permit has been issued as per 1910.146 and local Confined Space Program.			

For specific requirements refer to General Industry Standards 1910.146; 1910.252; .253; .254 and .272 and Construction Standards 1926.803; .350; .352 and .353.

I attest that the above precautions have been taken:

_____ Printed Name of Person Responsible for Performing Hot Work	_____ Signature
--	--------------------

Approval:

_____ Facility Manager - Printed Name	_____ Facility Manager - Signature
--	---------------------------------------

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SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Submittals listed or specified in this Contract shall conform to the provisions of this section, unless explicitly stated otherwise.

1.2 REFERENCES

NOT USED

1.3 DEFINITIONS

- A. Submittal Definition: Shop drawings, product data, samples, administrative and closeout submittals, and additional data presented for review and approval. Contract clauses referring to material, workmanship specifications and drawings for construction shall apply to all submittals.
- B. Types of Submittals
 - 1. Shop Drawings. As used in this Section, drawings, schedules, diagrams, and other data prepared specifically for this contract, by the Contractor or through the Contractor by way of a subcontractor, manufacturer, supplier, distributor, or other lower tier contractor, to illustrate a portion of the work.
 - 2. Product Data. Preprinted material such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate a portion of the work, but not prepared exclusively for this Contract. Information such as mix design, material characteristics, and similar data is included herein.
 - 3. Samples. Physical examples of products, materials, equipment, assemblies, or workmanship, physically identical to a portion of the work, illustrating a portion of the work or establishing standards for evaluating the appearance of the finished work or both.
 - 4. Administrative and Closeout Submittals. Submittals of data for which reviews and approval will be to ensure that the administrative requirements of the project are adequately met but not to ensure directly that the work is in accordance with the design concept and in compliance with the contract documents.
- C. Approving Authority: Contracting Officer's Representative (COR) or Resident Engineer (RE).
- D. Work: As used in this Section, the construction required by the contract documents, including labor necessary to produce the construction and materials, products, equipment, and systems incorporated or to be incorporated in such construction and including materials, products, equipment, and systems produced both on-and off-site.

1.4 SUBMITTALS

A. Submit the following in accordance with the requirements of this section.

1. Submittal status log: List each submittal. Include for each submittal the specification section number; description of item for which the submittal is required; and the Contractor's scheduled date for the submittal. Submit the log within 15 days after notice to proceed. Indicate required approval date to maintain project schedule.

1.5 PROCEDURES FOR SUBMITTALS

A. Limits and Constraints Regarding Submittals

1. Submittals shall be complete for each portion of the work; components of the work interrelated as a system shall be submitted at the same time.
2. When submittal acceptability is dependent on conditions, items, or materials included in separate subsequent submittals, the submittal will be returned without review.
3. Submittals of information not required as a submittal, or covering work for which the submittals have been returned as "No Exceptions Taken" will be returned without review.
4. Approval of a separate material, product, or component does not imply approval of assembly in which the item functions.
5. The work shall conform to approved submittals, except contractor shall conform to the contract requirements and resubmit the submittal if a previously approved submittal has an error or omission.
6. When submitting for approval material which is other than that cited in the contract, submit the necessary scale drawings, wiring and control diagrams, cuts or entire catalogs, pamphlets, descriptive literature, and performance and test data of both the material specified and the material he wishes to substitute in the number of copies of each as required under the contract.

B. Scheduling of Submittals

1. Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittal processing. Coordinate and sequence different categories of submittals for same work, and for interfacing units of work, so that one will not be delayed for coordination with another.
2. Except as specified otherwise, allow a review period, beginning with receipt by the approval authority, that includes at least 20 working days.

C. Substitutions: Substitutions from contract requirements require Government approval and will be considered where advantageous to the Government. Where substitutions are proposed for consideration, submit a written request, with documentation of the nature and features of the substitution and why the substitution is desirable and beneficial to the Government. The proposed substitution shall be identified separately and included along with the required submittal for the item. When a substitution is submitted for approval, the Contractor warrants the following:

1. Substitution Is Compatible: The Contract has been reviewed to establish that the substitution, when incorporated, will be compatible with other elements of the work.
 2. Contractor is Responsible: The Contractor shall take action and bear the additional cost, including review costs by the Government, necessary because of the proposed substitution.
- D. Resubmittal Costs: Initial submittals requiring Government approval will be reviewed at no cost to the Contractor. The cost of reviewing resubmittals, for reason of failure of the initial submittal to meet contract requirements, shall be the responsibility of the Contractor. The COR will issue a deductive contract modification to reduce the contract price by \$350.00 for each resubmittal of items requiring Government review and approval. The contract completion date will not be extended due to non-compliance with submittal requirements.
- E. Contractor's Responsibilities:
1. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and Contract documents.
 2. Ensure that material is clearly legible. Ensure required specialty stamps are affixed and signed.
 3. Stamp each sheet of each submittal with the Contractor's certifying stamp, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only. Word the submittal stamp as follows:
"I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated into Contract Number _____, is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is submitted for Government approval.
Certified by _____ Date _____"
 4. Sign the Contractor's certification. The person signing the certification shall be one designated in writing by the Contractor as having that authority. The signature shall be in original ink. Stamped signatures are not acceptable.
 5. Transmit submittals to the approving authority in orderly sequence, in accordance with the Submittal Status Log, and to prevent project delays and delays in work by the Government or separate contractors.
 6. Advise the approving authority of substitution, as required by the paragraph entitled "Substitutions."
 7. Correct and resubmit submittal as directed by the approving authority. Direct specific attention, in writing or on resubmitted submittal, to revisions not requested by the approving authority on previous submissions.
 8. Retain a copy of approved submittals at the project site, including the Contractor's copy of approved samples.
 9. Furnish additional copies of submittals if requested by the COR.
 10. Ensure no work is begun until the submittals for that work have been returned with a review comment other than "Revise and Resubmit" or "Rejected".
- F. Approving Authority's Responsibilities:
1. Submittals will be reviewed for approval with reasonable promptness and only for conformance with project design concepts and compliance with the contract documents.

- If a substitution is not identified as required by the paragraph entitled "Substitution", then the approval of the submittal SHALL NOT be an approval of the substitution.
2. The checking, marking or approval of the shop drawings and/or product data by the COR shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Approval will not relieve the contractor of the responsibility for any error which may exist. The contractor shall be responsible for the dimensions and design of adequate connections, details, and satisfactory construction of all work.
 3. Submittals will be returned with one of the following notations:
 - a. Submittals marked "As Submitted" indicate the work may proceed as presented in the submittal.
 - b. Submittals marked "Not Approved" indicate the submittal has failed to meet the specification requirements and work may not proceed.
 - c. Submittals marked "As Noted" indicate there are markings in the submittal that must be included to result in an acceptable submittal. Contractor may proceed with the work by accepting and incorporating the markings in the finished work unless the "Revise and Resubmit" box is checked.
 - d. Submittals marked "Revise and Resubmit" must be modified and resubmitted. The revised submittal number must indicate that it is a resubmittal of a rejected submittal.

- G. The transmittal sheet returning the submittal will be initialed.

1.6 FORMAT AND QUANTITY OF SUBMITTALS

- A. Transmittal Form: Transmit each submittal, except sample installations and sample panels, to the office of the approving authority. Transmit submittals with a transmittal form approved by the COR and standard for the project. The transmittal form shall identify the Contractor, indicate the date of the submittal, and include information prescribed by the transmitted form and required in the paragraph entitled "Identifying Submittals." Process transmittal forms to record actions regarding sample panels and sample installations.
- B. Identifying Submittals: Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on the transmittal form. Mark each copy of each submittal identically, with the following:
 1. Project title and location.
 2. Construction contract number.
 3. The Section number and paragraph number of the Section by which the submittal is required and the paragraph to which it conforms.
 4. The name, address, and telephone number of the subcontractor, supplier, manufacturer and any other second tier contractor associated with the submittal.
 5. Product identification and location in project.
- C. Format and Quantity for Shop Drawings
 1. For shop drawings presented on sheets larger than 11-inches by 17 inches, submit two

- printed copies and one Portable Document Format (PDF) file transmitted on 700 MB compact disks (CD) of each shop drawing prepared for this project.
2. For shop drawings presented on sheets 11-inches by 17 inches or less, submit two printed copies with each bound in a separate volume and a PDF file transmitted on 700 MB compact disks (CD) of each shop drawing prepared for this project.
 3. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to the information required in the paragraph entitled "Identifying Submittals."
 4. Dimension drawings, except diagrams and schematic drawings; prepare dimensioned drawings to scale. Identify materials and products for work shown.
 5. Shop drawings shall be not less than 8 1/2 by 11 inches or more than 36 by 42 inches.
 6. After review, the approving authority will return a PDF file and a marked original.

D. Format and Quantity for Product Data

1. Submit two printed copies with each, bound in a separate volume and a PDF file transmitted on compact disk (CD) or diskette of each Product Data prepared for this project.
2. Present submittals for each Section as a complete, bound volume. Include a table of contents listing page and catalog item numbers for product data.
3. Indicate, by prominent notation, each product that is being submitted; indicate the Section and paragraph numbers to which it pertains.
4. Supplement product data with material prepared for the project to satisfy submittal requirements for which product data does not exist. Note that the material is developed specifically for the project.

E. Format and Quantity of Samples:

1. Furnish samples in the sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately the same size as specified:
 - a. Sample of equipment or device: Full size.
 - b. Sample of materials less than 2 by 3 inches: Built up to 8 1/2 by 11 inches.
 - c. Sample of materials exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.
 - d. Sample of linear devices or materials such as conduit and handrails: 10-inch length or length to be supplied, if less than 10 inches.
 - e. Sample of non-solid materials such as sand and paint: Pint.
 - f. Color selection samples: 2 inches by 4 inches.
 - g. Sample panel: 4 feet by 4 feet.
 - h. Sample Installation: 100 square feet.
2. Samples showing range of variation: Where variations are unavoidable due to the nature of the materials, submit sets of samples of not less than three units showing the extremes and middle of the range.
3. Quantity, unless otherwise specified:
 - a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by the

- approving authority and one will be returned to the Contractor.
 - b. Submit one sample panel. Include components listed in technical section or as directed.
 - c. Submit one sample installation, where directed.
 - 4. Reusable samples: Incorporate returned samples into the work only if so specified or indicated. Incorporated samples shall be in undamaged condition at the time of use.
 - 5. Recording of sample installation: Note and preserve the notation of the area constituting the sample installation but remove the notation at the final clean up of the project.
 - 6. When a color, texture or pattern is specified in naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.
 - 7. Transmittal Form for samples shall identify manufacturer, model, type, color, etc. sufficient to reorder or replace.
- F. Format and Quantity of Administrative and Closeout Submittals
- 1. Unless otherwise specified, submit administrative and closeout submittals in the format and quantities required for shop drawings.
 - 2. Comply with section entitled "Contract Closeout Procedures".
- G. A Portable Document Format (PDF) file for each shop drawing, product data, and sample transmittals shall be uploaded to FAA's KSN website.

1.7 PROGRESS PHOTOGRAPHIC SUBMITTALS

- A. Still Photographs: Before construction operations have started at the site, the contractor shall take and provide 25 color photographs showing the existing conditions and thereafter an average of 25 views shall be taken each month until completion of the work. An electronic file of each view shall be submitted to the RE promptly after taking the views.
- 1. Photographs shall be made using a digital camera of at least 4 mega pixel size. All digital images shall be submitted on CD along with the monthly photographs.
 - 2. The contractor shall notify the RE 24 hours in advance of taking any photographs.
- B. Ownership of Photographs: Any and all still photographs, digital files, and video tapes taken of the construction area are the property of FAA and shall not be released to any source whatsoever without the prior written permission from the RE. This provision shall prevail for the duration of the contract and indefinitely thereafter.
- C. Video Photography: Video photography will not be allowed on-site or inside the facility.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 33 00

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SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
1. Inspection procedures.
 2. Punch list.
 3. Warranties.

1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following: List items below that are incomplete in the request.
1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 2. Advise FAA of pending insurance changeover requirements.
 3. Obtain and submit releases permitting FAA unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 4. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
 5. Deliver tools, spare parts, extra materials, and similar items to location designated by FAA. Label with manufacturer's name and model number where applicable.
 6. Make final changeover of permanent locks and deliver keys to FAA. Advise FAA's personnel of changeover in security provisions.
 7. Complete startup testing of systems.
 8. Submit test/adjust/balance records.
 9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 10. Advise FAA of changeover in utilities.
 11. Submit changeover information related to FAA's occupancy, use, operation, and maintenance.
 12. Complete final cleaning requirements, including touchup painting.
 13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion, also referred to as the Contractor Acceptance Inspection (CAI). On receipt of request, COTR will either schedule the inspection within 7 days or notify Contractor of unfulfilled requirements. COTR will prepare the Certificate of Substantial Completion after the inspection or will notify Contractor of items, either on Contractor's list or additional items identified by COTR, that must be completed or corrected before certificate will be issued. COTR will also provide a punch list that will form the basis of requirements for the Final Completion.

1.3 FINAL COMPLETION

- A. Preliminary Procedures: Contractor should request final inspection prior to contract completion date. Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a Final Application for Payment.
 2. Submit certified copy of COTR's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by COTR. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit a letter from the airport certifying that work areas located on the airport were left in a satisfactory condition.
 5. Perform a final cleaning in accordance with Section 01 10 00.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, COTR will either proceed with inspection or notify Contractor of unfulfilled requirements. COTR will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.4 WARRANTIES

- A. Submit warranties in accordance with Section 01 10 00. Warranty period shall begin on date of Substantial Completion as listed in Certificate of Substantial Completion.
- B. Partial Occupancy: Submit properly executed warranties within fifteen (15) days of completion of designated portions of the Work that are completed and occupied or used by FAA during construction period by separate agreement with Contractor.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 77 00

SECTION 02 01 00 – INTERIM LIFE SAFETY MEASURES FOR FACILITIES UNDER CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY OF WORK

- A. During construction activities, it is likely temporary hazards may be posed due to the work being conducted in the facility. Interim Life Safety Measures (ILSM) are actions that must be taken to compensate for the temporary hazards. This document addresses administrative actions which must be taken to ensure the current level of life safety is maintained at all times and occupants are not subjected to hazardous conditions for even short periods of time.
- B. Implementation and Enforcement: Implementation and enforcement of ILSM is the responsibility of all occupants within the building, including employees and construction personnel. However, primary identification of hazards and the actions taken to compensate for temporary hazards are the responsibility of the Contractor. All ILSM are subject to approval by the Resident Engineer.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION MEETING

- A. Prior to commencement of construction, conduct a meeting to inform all Tower and Base Building occupants (employees and construction personnel) of the project scope and duration. This should include, at a minimum, the following:
 - 1. An overview of the construction project.
 - 2. A preliminary schedule for the construction.
 - 3. Discussion of affected fire protection and life safety systems including, active and passive features.
 - 4. Discussions of the effect on daily and emergency operations.
 - 5. Handout of written policies for ILSM for all employees and construction personnel.
 - 6. Demonstration of signs, messages, etc., to be used to identify hazardous conditions and the corresponding ILSM.
 - 7. List of contacts for reporting hazardous conditions.
 - 8. Discussion of anticipated hazards throughout the project and the ILSM for each.

3.2 ACTIVE AND PASSIVE FIRE PROTECTION AND LIFE SAFETY FEATURES

- A. Due to the criticality of FAA facilities, most facilities are provided with a number of active and passive fire protection and life safety features. If any of these features are compromised in any way, ILSM shall be instituted immediately. These features include:
 - 1. Fire-resistive construction.
 - 2. Stair ventilation system (stair pressurization or vented vestibule).
 - 3. Fire detection and alarm system.
 - 4. Exit signage.
 - 5. HVAC shutdown.
 - 6. Unlocking security doors.

3.3 SITUATIONS COMPROMISING LIFE SAFETY

- A. General concepts of situations which compromise the level of life safety as required by the applicable codes and standards include:
 - 1. Blocked or obstructed exits.
 - 2. Obstructed access for emergency vehicles and personnel.
 - 3. Fire protection system malfunctioning or out of service.
 - 4. Storage of additional combustibles or flammable liquids.
 - 5. Temporary sources of ignition due to construction activities (cutting, welding, etc.).
 - 6. Temporary penetrations in fire-rated walls and partitions (including missing doors).
- B. Single Means of Egress: All work shall be conducted in such a way as to not obstruct or compromise the single means of egress from the ATCT.

3.4 SMOKING

- A. Smoking will not be permitted in areas under construction at any time in FAA facilities.

3.5 NOTIFICATION SIGNAGE

- A. The Contractor shall provide appropriate signage, in locations approved by the Resident Engineer, to notify occupants of current activities and ILSM in effect at the facility. The signage shall be verified prior to each construction shift and employee shift. The signage shall indicate the present hazards and the safety measure provided to compensate for the hazards.

3.6 QUALITY CONTROL

- A. During construction, the following practices shall be adhered to in addition to those required for specific hazards discussed below:

1. Construction personnel shall check all doors opening into stairs to ensure door hardware is functioning properly. This includes a visual inspection of all doors to ensure the construction has not been compromised and checking all door hardware including latching hardware and self-closing devices to verify proper operation. Any deficient components shall be repaired or replaced immediately.
2. The temporary use of wood chocks or other objects to prop open fire-rated doors shall be permitted as necessary for construction work. At the completion of work for the day, the construction supervisor shall verify all propped doors have been returned to the closed position.
3. The construction supervisor shall inspect the job site a minimum of twice per week to verify all life safety features are present and operational and have not been damaged by construction, including:
 - a. Exit signage.
 - b. Exits are free of storage or obstructions.
 - c. Exit stairs, including treads, landings, handrails, headroom.
 - d. Exit illumination.
 - e. Emergency lighting (battery-operated).
 - f. Evacuation route maps (ensure these are installed and readily visible).
4. If the fire alarm system is not provided with offsite monitoring, provide a telephone with a direct line to the fire department for notification in case of a fire. The Resident Engineer shall approve the location of the telephone.
5. Inform the fire department of construction activities in the facility and provide them a copy of written ILSM policies. The Contractor shall regularly update the fire department on the status of construction and ILSM (minimum of once every two weeks).

3.7 OPERATIONAL FIRE ALARM SYSTEM

- A. If the facility fire alarm system is not operational, is malfunctioning, or is in a trouble condition due to construction activities, the Contractor shall provide, at a minimum, the following additional ILSM.
- B. Inform Fire Department: Inform the fire department of the problems with the facility fire alarm system and inform them of the ILSM being taken to compensate for the deficient system.
- C. Trouble Signals: Ensure trouble signals at the main fire alarm control panel and the Cab and TRACON annunciator panels remain functional until the system is returned to proper function. Trouble signals at either panel shall not be bypassed.
- D. Magnetic Door Hold-Open Devices: Test magnetic door holders to ensure these devices still operate via the fire alarm system. If door holders do not work, all door holders shall be disabled and shall not be returned to use until the fire alarm system is returned to normal.
- E. Facility Inspections: Construction supervisors shall inspect all areas prior to each shift to ensure all active and passive fire protection features are still operational including all

fire doors are in closed position and are not propped open, and the sprinkler system is still functional (i.e. valves are in the open position), if applicable.

- F. Fire Alarm Inoperable at End of Shift: If the fire alarm system is not operational at the end of the construction shift, provide a temporary, manual switch in the Cab to activate the stair ventilation system (ATCT's only).

3.8 TEMPORARY IGNITION SOURCES

- A. When construction activities involve the use of temporary ignition sources ("hot works"), i.e. welding, cutting, plumbers torch, etc., the Contractor shall provide, at a minimum, the following ILSM. (Note: Additional measures may be required by the Resident Engineer for specific situations.)
 - 1. Inform construction supervisor of hazardous operations.
 - 2. Keep a log of all hot work activities.
 - 3. Provide the appropriate type fire extinguisher to the personnel performing the work (all construction personnel shall be trained in the proper use of fire extinguishers prior to the commencement of work).
 - 4. Disable any fire alarm initiating devices or zones that may be susceptible to a false alarm during the operation. Notify the Resident Engineer prior to disabling fire alarm devices.
 - 5. Return all fire alarm devices to normal operation at the completion of work. At the end of the shift, all fire alarm devices shall be returned to operational condition regardless of the status of the work.

3.9 STORAGE OF COMBUSTIBLES

- A. When construction activities involve the storage of an unusual amount of combustibles and/or combustible liquids within the facility, the Contractor shall provide, at a minimum, the following ILSM. (NOTE: The Specification addressed Contractor storage spaces and other limitations. Additional measures may be required by the Resident Engineer for specific situations.)
 - 1. Submit a written request to the Resident Engineer requesting permission to store materials within the facility. The request shall indicate the proposed location, types and quantities of combustibles, MSDS sheets (if applicable), approximate duration of storage and proposed ILSM. The Resident Engineer will provide a copy of all requests to the FAA Safety and Environmental Compliance Manager.
 - 2. Provide additional fire extinguishers appropriate for the anticipated hazard.
 - 3. Ensure proper cleaning techniques are utilized in the storage area at the end of each shift. This includes cleaning all dust and waste materials, replacing lids on liquids, cleaning all spills, returning all flammable and combustible liquids to a flammable liquids storage locker.
 - 4. Check throughout the storage area daily for exposed ignition sources. Any exposed ignition sources shall be repaired or removed from the storage area.

3.10 STAIR VENTILATION SYSTEM

- A. Conduct a meeting to inform all air traffic personnel upon restoring the stair ventilation system to normal operation.

END OF SECTION 02 01 00

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SECTION 02 03 00 – GENERAL REQUIREMENTS FOR DEMOLITION AND RENOVATION

PART 1 - GENERAL

1.1 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)
 - 1. AHRI Guideline K (2005) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants
- C. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
 - 1. AASHTO M 145 (1991; R 2004) Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
 - 2. AASHTO T 180 (2001; R 2004) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop
- D. AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)
 - 1. ASSE/SAFE A10.6 (2006) Safety Requirements for Demolition Operations
- E. CARPET AND RUG INSTITUTE (CRI)
 - 1. CRI (2009) CRI Carpet Installation Standard
- F. U.S. ARMY CORPS OF ENGINEERS (USACE)
 - 1. EM 385-1-1 (2008) Safety and Health Requirements Manual
- G. U.S. DEPARTMENT OF DEFENSE (DOD)
 - 1. DOD 4000.25-1-M (2006; Notice 1) Requisitioning and Issue Procedures
- H. U.S. FEDERAL AVIATION ADMINISTRATION (FAA)
 - 1. FAA AC 70/7460-1 (Rev K) Obstruction Marking and Lighting
- I. U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
 - 1. 40 CFR 61 National Emission Standards for Hazardous Air Pollutants
 - 2. 40 CFR 82 Protection of Stratospheric Ozone
 - 3. 49 CFR 173.301 Shipment of Compressed Gases in Cylinders and Spherical Pressure Vessels

1.2 GENERAL REQUIREMENTS

- A. This Section specifies administrative and procedural requirements for demolition and renovation. Refer to other Sections for specific work requirements and limitations applicable to individual parts of the work. Requirements of this Section apply to all disciplines. Refer to specific Sections for other requirements and limitations applicable to the work.
- B. Do not begin demolition until authorization is received from the COTR/RE. Do not allow accumulations inside or outside the building. The work includes demolition and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the COTR/RE. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.
- C. Protection of Existing Property: Before beginning any demolition work, the Contractor shall carefully survey the site and examine the drawings and specification to determine the extent of the work. The Contractor shall take all necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government, and any damaged items shall be repaired or replaced as approved by the COTR/RE at no additional cost to the Government. The Contractor shall carefully coordinate the work of this section with all other work and shall construct and maintain shoring, bracing and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.
- D. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio. Obtain written permission from the COTR/RE before cutting, disconnecting, disturbing, patching, etc. any structural element.
- E. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.
- F. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the COTR/RE's opinion, reduce the building's aesthetic qualities or result in visual evidence of cutting and patching. Remove and replace work cut and patched in a visually unsatisfactory manner.

1.3 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:
 - 1. Demolition Plan

1.4 REGULATORY AND SAFETY REQUIREMENTS

- A. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6.
- B. Notifications:
 - 1. General Requirements: Furnish timely notification of demolition projects to the COTR/RE in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M.

1.5 DUST AND DEBRIS CONTROL

- A. Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Vacuum and dust the work area daily.

1.6 PROTECTION

- A. Traffic Control Signs:
 - 1. Where pedestrian, driver or aircraft safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the COTR/RE prior to beginning such work.
 - 2. Contractor must provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet 30 meter above ground level. Light construction and installation must comply with FAA AC 70/7460-1. Lights must be operational during periods of reduced visibility, darkness, and as directed by the COTR/RE. Maintain the temporary services during the period of construction and remove only after permanent services have been installed and tested and are in operation.
- B. Items to Remain in Place: Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the COTR/RE. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition work. Repairs, reinforcement, or structural replacement require approval by the COTR/RE prior to performing such work.
- C. Existing Construction Limits and Protection: Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove snow, dust, dirt, and debris from work areas daily.
- D. Weather Protection: For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

- E. Trees: Protect trees within the project site which might be damaged during demolition, and which are indicated to be left in place. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the COTR/RE.
- F. Utility Service: Maintain existing utilities indicated to stay in service and protect against damage during demolition and operations. Coordinate with COTR/RE for shutdown utilities.
- G. Facilities: Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated on drawings, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the COTR/RE. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.
- H. Protection of Personnel: Before, during and after the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished or deconstructed and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.7 BURNING

- A. The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.8 RELOCATIONS

- A. Perform the removal and reinstallation of relocated items as indicated on drawings with workmen skilled in the trades involved. Items to be relocated which are damaged by the Contractor shall be repaired or replaced with new undamaged items as approved by the COTR/RE.

1.9 REQUIRED DATA

- A. Prepare a Demolition Plan. Include in the plan procedures for careful removal and disposition of materials to be reused, coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by COTR/RE prior to work beginning.

1.10 ENVIRONMENTAL PROTECTION

- A. Comply with the Environmental Protection Agency requirements specified.

1.11 USE OF EXPLOSIVES

- A. Use of explosives will not be permitted.

1.12 ASBESTOS CONTAINING MATERIALS (ACM)

- A. It is the intent of this Specification to not disturb any equipment, materials, etc. that contain asbestos. If asbestos containing materials are discovered, the RE shall be notified immediately. New or used materials, equipment, etc. will not be allowed on-site if they contain asbestos.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Prior to Cutting Existing Surfaces: Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.
- B. Prior to Proceeding: Meet at the site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

- A. Provide temporary support of work to be cut. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 EXISTING FACILITIES TO BE REMOVED

A. GENERAL

1. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse.

2. Cutting and Patching:

- a. Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
 - b. Cutting: Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition. Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible, review proposed procedures with the original installer; comply with original installer's recommendations. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 1) Avoid Marring Existing Surfaces: To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 - 2) Concrete and Masonry Surfaces: Cut through concrete and masonry using a cutting machine such as carborundum saw or diamond core drill.
 - 3) Utility Services: Bypass utility services such as pipe or conduit before cutting, where services are shown or required to be removed, relocated or abandoned. Remove pipe or conduit in walls or partitions that are noted to be removed, unless noted by Resident Engineer to be cut-off. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after bypassing and cutting. Use approved firestopping methods in all fire-rated walls, floors or ceilings.
 - c. Patch: Patch with durable seams that are as invisible as possible. Comply with specified tolerances. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
 - d. Finish Restoration: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - e. Finish Restoration in More than One Area: Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - f. Smooth Painted Surfaces: Where patching occurs in a smooth painted surface, extend final paint coat over entire area containing the patch, after the patched area has received primer and second coat.
 - g. Existing Ceilings: Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.
3. Items with Unique/Regulated Disposal Requirements: Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

B. ARCHITECTURAL

1. Carpentry: Remove and reinstall components as whole units, complete with trim and accessories as indicated on drawings. Do not remove hardware attached to units, except for door closers unless noted otherwise in drawings. Brace the open end of door frames to prevent damage.
2. Carpet: Remove existing carpet in accordance with manufacturer recommendations. Remove adhesive according to recommendations of the Carpet and Rug Institute (CRI). Adhesive removal solvents shall comply with CRI 104.
3. Acoustic Ceiling Tile: Remove and store ceiling tiles to be reused if indicated on drawings.

C. STRUCTURAL

1. Miscellaneous Metal: When shop-fabricated items such as access doors and frames, steel gratings, metal ladders, metal railings, metal windows and similar items and light-gage and cold-formed metal framing, metal toilet partitions, toilet accessories and similar items will be reused, removed them as whole units and shall be store and protected from weather.

D. MECHANICAL

1. Mechanical Equipment and Fixtures: Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Mechanical equipment and fixtures must be disconnected at fittings. Remove service valves attached to the unit. Do not remove equipment until approved.
2. Piping: Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property.

E. ELECTRICAL

1. Electrical Equipment and Fixtures: Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.
 - a. Fixtures: Remove electrical fixtures as indicated on drawings.
 - b. Electrical Devices: Remove switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items as indicated on drawings.

- c. Wiring Ducts or Troughs: Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway as indicated on drawings.
- d. Conduit and Miscellaneous Items: Remove conduit except where embedded in concrete or masonry as indicated on drawings. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.4 DISPOSITION OF MATERIAL

- A. Title to Materials: All materials and equipment removed shall become the property of the Contractor and shall be removed from Government property.
- B. Reuse of Materials and Equipment: Remove and store materials and equipment indicated to be reused to prevent damage, and reinstall as the work progresses.
- C. Disposal of Ozone Depleting Substance (ODS): Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be removed from Government property and disposed of in accordance with 40 CFR 82. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.
 - 1. Special Instructions: No more than one type of ODS is permitted in each container. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:
 - a. Activity name and unit identification code.
 - b. Activity point of contact and phone number.
 - c. Type of ODS and pounds of ODS contained.
 - d. Date of shipment.
 - 2. Fire Suppression Containers: Deactivate fire suppression system cylinders and canisters with electrical charges or initiators prior to shipment. Also, safety caps must be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.
- D. Transportation Guidance: Ship all ODS containers in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.5 DISPOSAL OF REMOVED MATERIALS

- A. Regulation of Removed Materials: Dispose of debris, rubbish, scrap, and other materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified.
- B. Burning on Government Property: Burning of materials removed from demolished structures will not be permitted on Government property.
- C. Removal to Spoil Areas on Government Property: Transport noncombustible materials removed from demolition structures to designated spoil areas on Government property.
- D. Removal from Government Property: Transport waste materials removed from demolished structures, from Government property for legal disposal. Dispose of waste soil as directed.

END OF SECTION 02 03 00

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SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. HVAC demolition.
6. Equipment installation requirements common to equipment sections.
7. Painting and finishing.
8. Supports and anchorages.

B. General: Work shall be performed in accordance with these specifications and good practice. No modifications to these specifications will be accepted without the expressed written approval of the COTR. It is the Contractor's responsibility to document COTR's approval of any such modifications prior to the execution of work. Requirements of these Specifications modified by any addenda, change orders, written approvals and written instructions issued by the COTR, if any, shall be as specifically identified by Section and Paragraph in those addenda, change orders, written approvals and written instructions. Approvals of submittals are subject to additional limitations described elsewhere in these Specifications. System concept drawing sheets are for information only to show potential system arrangement. Field verify information contained on these drawings and is responsible for design and installation of the system in accordance with the specifications. The bid drawings do not show all information necessary for installation of the system, but are intended to be used as a guide for the purpose of designing the systems and preparing a bid.

C. Removal of Debris and Salvage: Remove rubbish and debris resulting from work on a daily basis. Debris shall be disposed of offsite. Rubbish not removed by the Contractor will be removed by the FAA and back-charged to the Contractor. Removal of debris and rubbish from the premises shall be coordinated with the COTR.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.

1.4 QUALITY ASSURANCE

- A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
 1. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
- K. Verify final equipment locations for roughing-in.

- L. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 2. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with NEMA MG-10 Energy Management Guide For Selection and use of Polyphase Motors.
- D. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- B. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

- C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13

SECTION 23 05 19 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermometers.
2. Gages.
3. Test plugs.

B. DEFINITIONS

- C. CR: Chlorosulfonated polyethylene synthetic rubber.
- D. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.
- B. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: For each type of thermometer and gage, signed by product manufacturer.
- D. Operation and Maintenance Data: For Thermometer and gages shall include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Palmer - Wahl Instruments Inc.
 2. Trerice, H. O. Co.
 3. Weiss Instruments, Inc.
 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Die-cast aluminum or brass , 7 inches long.

- C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens. Mercury shall not be used.
- D. Tube Background: Satin-faced, non-reflective aluminum with permanently etched scale markings.
- E. Window: Glass .
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device .
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 THERMOWELLS

- A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 2. Palmer - Wahl Instruments Inc.
 - 3. Trerice, H. O. Co.
 - 4. Weiss Instruments, Inc.
 - 5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Manufacturers: Same as manufacturer of thermometer being used.
- C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.3 PRESSURE GAGES

- A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 2. Palmer - Wahl Instruments Inc.
 - 3. Trerice, H. O. Co.
 - 4. Weiss Instruments, Inc.
 - 5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Dry type, drawn steel or cast aluminum , 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass .
8. Ring: Metal .
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 ball valve or stainless-steel needle type.
2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.4 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Peterson Equipment Co., Inc.
2. Sisco Manufacturing Co.
3. Trerice, H. O. Co.
4. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:

1. Inlet and outlet of each chiller.

B. Provide the following temperature ranges for thermometers:

1. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions .

3.2 GAGE APPLICATIONS

- A. Install dry -case-type pressure gages at chilled-water inlets and outlets of chillers.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install ball or needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).
- E. Install test plugs in tees in piping.

3.4 ADJUSTING

- A. Adjust faces of gages and thermometers to proper angle for best visibility.

END OF SECTION 23 05 19

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.3 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B31.9 for building services piping valves.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, and weld ends.

3. Set ball and plug valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- E. Valve-End Connections:
 1. Solder Joint: With sockets according to ASME B16.18.
 2. Threaded: With threads according to ASME B1.20.1.
- F. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

- A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
 1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Hammond Valve.
 - d. Jamesbury; a subsidiary of Metso Automation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Standard: MSS SP-110.
 - h. SWP Rating: 150 psig.
 - i. CWP Rating: 600 psig.

- j. Body Design: Two piece.
- k. Body Material: Forged brass.
- l. Ends: Threaded.
- m. Seats: PTFE or TFE.
- n. Stem: Brass.
- o. Ball: Chrome-plated brass.
- p. Port: Full.

B. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Hammond Valve.
 - d. Jamesbury; a subsidiary of Metso Automation.
 - e. Milwaukee Valve Company.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.

- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
- B. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 1/2 and Smaller:
 - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two piece, full port, brass or bronze with stainless-steel trim.

END OF SECTION 23 05 23

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
 - 1. Steel pipe hangers and supports for copper piping.
 - 2. Metal framing systems.
 - 3. Fastener systems.
 - 4. Equipment supports.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
- B. Shop Drawings: Signed and sealed by a qualified Licensed Professional Engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Metal framing systems. Include Product Data for components.
 - 2. Equipment supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Known Acceptable Source:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Grinnell Corp.
 - 3. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

2.3 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Known Acceptable Source:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Power-Strut Div.; Tyco International, Ltd.
 - 3. Tolco Inc.
 - 4. Unistrut Corp.; Tyco International, Ltd.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
 - 1. Hardware: Nuts, bolts and washers shall be stainless steel. Springs shall be galvanized or plastic coated.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Known Acceptable Source:

1. Carpenter & Paterson, Inc.
 2. ERICO/Michigan Hanger Co.
 3. PHS Industries, Inc.
 4. Pipe Shields, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 2. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 3. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
- F. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 2. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 3. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- G. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
- H. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- I. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- J. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- C. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- E. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- F. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- H. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - b. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - 4. Insert Material: Length at least as long as protective shield.
 - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.4 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 05 29

SECTION 23 05 33 - HEAT TRACING FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes heat tracing with the following electric heating cables:

1. Self-regulating, parallel resistance.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.
1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Calculations: Provide calculations to determine the following:
1. Maximum Heat Output (W/ft.)
 2. Number of Parallel Cables
 3. Spiral Wrap Pitch
- E. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Known Acceptable Source: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. BH Thermal Corporation.
 - 2. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
 - 3. Delta-Therm Corporation.
 - 4. Easy Heat Inc.
 - 5. Nelson Heat Trace.
 - 6. Pyrotenax; a division of Tyco Thermal Controls.
 - 7. Raychem; a division of Tyco Thermal Controls.
 - 8. Thermon Manufacturing Co.
 - 9. Trasor Corp.
- B. Heating Element: The self-regulating heating cable shall consist of two (2) 16 AWG nickel-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heating cable to be cut to length in the field. The heating cable shall be covered by a radiation-crosslinked, modified polyolefin dielectric jacket. To provide a ground path and to enhance the heating cable's ruggedness, the heating cable shall have a braid of tinned copper and an outer jacket of modified polyolefin, as required per section 427-23 of the NEC-1996.
- C. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- D. Electrical Insulating Jacket: Flame-retardant polyolefin.
- E. Maximum Operating Temperature (Power On): 150 deg F.
- F. Maximum Exposure Temperature (Power Off): 185 deg F.
- G. Capacities and Characteristics:
 - 1. Piping Diameter: <2 1/2 inch NPS.
 - 2. Volts: 120 V.
 - 3. Phase: Single
 - 4. Hertz: 60

2.2 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install electric heating cable across expansion joints according to manufacturer's written recommendations using slack cable to allow movement without damage to cable.
- B. Install electric heating cables after piping has been tested and before insulation is installed.
- C. Install electric heating cables according to IEEE 515.1.
- D. Install insulation over piping with electric cables according to Section 23 07 00 "HVAC Insulation."
- E. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- F. Set field-adjustable switches and circuit-breaker trip ranges.
- G. Protect installed heating cables, including nonheating leads, from damage.

3.3 CONNECTIONS

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 1. Test cables for electrical continuity and insulation integrity before energizing.
 - 2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 23 05 33

SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
2. Fire-rated insulation systems.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied jackets.
9. Tapes.
10. Securements.
11. Corner angles.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail attachment and covering of heat tracing inside insulation.
 3. Detail insulation application at pipe expansion joints for each type of insulation.
 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.
 8. Detail field application for each equipment type.
- C. Qualification Data: For qualified Installer.
- D. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- D. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 6. Preformed Pipe Insulation with Factory-Applied [ASJ] [ASJ-SSL]: Comply with ASTM C 552, Type II, Class 2.
 - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Aeroflex USA Inc.; Aeroseal.
- b. Armacell LCC; 520 Adhesive.
- c. Foster Products Corporation, H. B. Fuller Company; 85-75.
- d. RBX Corporation; Rubatex Contact Adhesive.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Encacel.
 - b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
 - c. Marathon Industries, Inc.; 570.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.

2.4 SEALANTS

- A. Joint Sealants:
 1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.

- b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Pittsburgh Corning Corporation; Pittseal 444.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Permanently flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 100 to plus 300 deg F.
 5. Color: White or gray.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. FSK and Metal Jacket Flashing Sealants:
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 2. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 3. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.
- B. Metal Jacket:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.6 TAPES

- A. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
 - b. **<Insert manufacturer's name; product name or designation.>**
2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.7 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.

2.8 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. Color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and prepare surfaces to be insulated. Remove materials that will adversely affect insulation application.
- B. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 6. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 7. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 8. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- #### A.
- Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

E. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by COTR, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.9 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Chilled Water Supply and Return:
 - 1. Insulation shall be the following:
 - a. Cellular Glass: 1 1/2 inches thick.
 - b. Flexible Elastomeric: 2 inches thick.

3.10 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
 - 1. Aluminum, Corrugated : 0.032 inch thick.

END OF SECTION 23 07 00

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

- 1. Chilled water piping.

1.2 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.

1.3 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

- 1. Chilled Water Piping: 125 psig at 100 deg F.

1.4 SUBMITTALS

- A. Product Data: For each type of the following:

- 1. Piping

- B. Shop Drawings: Detail, at 1/2 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

- C. Welding certificates.

- D. Qualification Data: For Installer.

- E. Field quality-control test reports.

- F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 WARRANTY

- A. Warranty: Manufacturer's agrees to repair or replace components that fail in materials or workmanship within specified warranty period, after assembly in field.

1. Warranty Period: Two year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Wrought-Copper Fittings: ASME B16.22.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- a. Anvil International, Inc.
- b. S. P. Fittings; a division of Star Pipe Products.
- C. Wrought-Copper Unions: ASME B16.22.

2.2 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, silver based lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

2.3 VALVES

- A. Ball and Butterfly Valves: Comply with requirements specified in Section 23 05 23 "General-Duty Valves for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Chilled-water piping, NPS 2 and smaller shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.

- B. Chilled-water piping, NPS 2-1/2 and larger shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping to permit valve servicing.
- C. Install piping at indicated slopes.
- D. Install piping free of sags and bends.
- E. Install fittings for changes in direction and branch connections.
- F. Install piping to allow application of insulation.
- G. Select system components with pressure rating equal to or greater than system operating pressure.
- H. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- I. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- J. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- K. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- L. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- M. Install valves according to Section 23 05 23 "General-Duty Valves for HVAC Piping."

- N. Install unions in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Steel pipe stanchion saddle, MSS Type 37
 - 2. Steel pipe saddle support, MSS Type 36
- C. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using silver based lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.6 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 4. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Pipe Cleaning:
1. Pipe Exterior: Wash and wipe the pipe exterior to remove construction dirt, loose scale and flux.
 2. Pipe Interior: Fully clean, flush and treat piping. Remove debris whether the debris was caused by construction activities or existed before the construction. Flush piping whether new or existing utilizing the flushing procedure described below. Any existing to remain piping that was left open to the atmosphere during construction must be cleaned and flushed. It is recommended that any existing to remain piping be sealed and filled with treated water during the construction process to prevent corrosion during construction.
 3. Pipe flushing procedure: Isolate the section of pipe to be cleaned with temporary caps, blind flanges, bypasses and spool pieces. Water shall be circulated through the piping utilizing an adequate temporarily installed strainer and pump with the intent to remove any and all foreign matter from the piping system and to prevent debris from entering any system equipment. During circulation of the water, remove as much foreign matter as possible by draining at low points and equipment inlets. Ensure desired drain flow does not exceed system water makeup capability. When the system appears to be free of foreign matter and the water runs clear, shut pumps down and remove strainer baskets, inspect and clean baskets removing any dirt/debris before re-installing. Repeat above procedures until system is determined by the Government representative to be clean and free of debris. Once the system is determined to be clean by the Government representative, recirculate water through equipment strainers, evaporators, condenser, and piping for (4) four hours. Shut down the temporary pump, drain equipment, remove evaporator and condenser water box covers for visual water box and tube inspection. Clean tubes found to be fouled or obstructed with debris. Repeat this procedure until strainers, evaporators, condensers and heat exchangers are determined to be clean by the Government representative.
- C. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.

4. Testing of the system with air pressure is an acceptable pretest but will not be accepted as the documented final test.
5. Subject piping system to hydrostatic test pressure that is not less than 150 psig. Do not use the system water to fill the piping for the test but fill from an external water source and vent air before the test. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
6. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
7. Prepare written report of testing.
8. Testing of the piping shall be applied to new pipe segments only.

D. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 23 25 00 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following HVAC water-treatment systems:

1. Bypass chemical-feed equipment and controls.
2. Chemical treatment test equipment.
3. HVAC water-treatment chemicals.

1.2 DEFINITIONS

- A. EEPROM: Electrically erasable, programmable read-only memory.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- C. TDS: Total dissolved solids.

1.3 PERFORMANCE REQUIREMENTS

- A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.
- B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment, material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- C. The chilled water system shall have the following water qualities:
1. pH: Maintain a value within 9.0 to 10.5.
 2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 3. Boron: Maintain a value within 100 to 200ppm.
 4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
 5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
 6. TDS: Maintain a maximum value of 10 ppm.
 7. Ammonia: Maintain a maximum value of 20 ppm.
 8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
 9. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
 - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
 - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.

- d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
- e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
 - 1. Bypass feeders.
 - 2. Chemical test equipment.
 - 3. Chemical material safety data sheets.
- B. Field quality-control test reports.
- C. Other Informational Submittals:
 - 1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
 - 2. Water Analysis: Illustrate water quality available at Project site.
 - 3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to COTR.

1.5 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

1.6 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for chilled-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:
 - 1. Initial water analysis and HVAC water-treatment recommendations.
 - 2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
 - 3. Periodic field service and consultation.
 - 4. Customer report charts and log sheets.
 - 5. Laboratory technical analysis.
 - 6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Known Acceptable Source: For chemical based water treatment systems, Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ampion Corp.
 2. Anderson Chemical Co, Inc.
 3. Aqua-Chem, Inc.; Cleaver-Brooks Div.
 4. Barclay Chemical Co.; Water Management, Inc.
 5. Boland Trane Services
 6. GE Betz.
 7. GE Osmonics.
 8. H-O-H Chemicals, Inc.
 9. Metro Group. Inc. (The); Metropolitan Refining Div.
 10. ONDEO Nalco Company.
 11. Watcon, Inc.

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

- A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
1. Capacity: 2 gallons
 2. Minimum Working Pressure: 175 psig

2.3 CHEMICAL TREATMENT TEST EQUIPMENT

- A. Test Kit: Manufacturer recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness.

2.4 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

- A. Install chemical application equipment on existing piping, level and plumb. Maintain manufacturer's recommended clearances. Arrange unit so controls and devices that require servicing are accessible.
- B. Install water testing equipment on wall near water chemical application equipment.
- C. Bypass Feeders: Install in closed hydronic systems, including chilled water and equipped with the following:
 - 1. Install bypass feeder in a bypass circuit around circulating pumps.
 - 2. Install a full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
 - 3. Install a swing check on inlet after the isolation valve.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train FAA's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION 23 25 00

SECTION 23 64 23 - SCROLL WATER CHILLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packaged, air-cooled, electric-motor-driven, scroll water chillers.

1.2 DEFINITIONS

- A. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.
- B. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.
- C. IPLV: Integrated part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.
- D. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.
- E. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Scroll water chillers shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- B. Cooling Capacity: The chiller shall be rated at not less than 50 tons at the site design conditions. Existing chilled water flow is 95.8 gpm and existing chilled water temperatures are 44F supply and 54F return at an ambient of 95DB and 79MCWB. Provide capacity control for operation down to -20 degrees F. Capacity control shall be by one or more of the following or combination thereof:
 1. Staging the condenser fan operation.

2. Condenser fan speed control.
3. Condenser airflow regulation by inlet or outlet automatic dampers.

1.4 SUBMITTALS

- A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
1. Performance at ARI standard conditions and at conditions indicated.
 2. Performance at ARI standard unloading conditions.
 3. Minimum evaporator flow rate.
 4. Refrigerant capacity of water chiller.
 5. Oil capacity of water chiller.
 6. Fluid capacity of evaporator.
 7. Characteristics of safety relief valves.
 8. Minimum entering condenser-air temperature
 9. Performance at varying capacity with constant design entering condenser-air temperature. Repeat performance at varying capacity for different entering condenser-air temperatures from design to minimum in 10 deg F increments.
- B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:
1. Assembled unit dimensions.
 2. Weight and load distribution.
 3. Required clearances for maintenance and operation.
 4. Size and location of piping and wiring connections.
 5. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Installation plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Structural supports.
 2. Piping roughing-in requirements.
 3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
 4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.
- D. Certificates: For certification required in "Quality Assurance" Article.
- E. Seismic Qualification Certificates: For water chillers, accessories, and components from manufacturers.
1. Basis for Certification: Indicate whether the withstand certification is based on actual test of assembled components or on calculations.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- F. Source quality-control test reports.
- G. Startup service reports.
- H. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.
- I. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

- A. ARI Certification: Certify chiller according to ARI 590 certification program.
- B. ARI Rating: Rate water chiller performance according to requirements in ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."
- C. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.
- D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2010, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.
- F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.
- B. Package water chiller for export shipping.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes, locations, and anchoring attachments to the existing concrete pad.
- C. Coordinate placement of chiller with existing electrical conduit protruding from the existing concrete pad.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified period.

1. Compressor Warranty Period: Standard warranty period 5 years parts labor and refrigerant from date of Contractor Acceptance Inspection (CAI). Quote for eight years parts, labor and refrigerant warranty from date of CAI.
2. Remainder of Chiller Warranty: Standard chiller warranty period 1 year parts, labor and refrigerant from date of CAI. Quotes for parts, labor and refrigerant warranty, (excluding compressor) for two, five, and eight years from date of CAI.
3. Extended Warranty Plus Maintenance: Provide as part of the proposal additional quotes to include monthly inspections and periodic maintenance as recommended by the chiller manufacturer for one, two, five and eight years.

PART 2 - PRODUCTS

2.1 PACKAGED AIR-COOLED WATER CHILLERS

- A. Known Acceptable Source: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Carrier Corporation; a United Technologies company.
 2. Trane; A Business Of Ingersoll-Rand
 3. York International Corporation.
- B. Description: Factory-assembled and run-tested water chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, evaporator, condenser coils, condenser fans and motors, electrical power, controls, and accessories.
- C. Fabricate base, frame, and attachment to water chiller components strong enough to resist movement during a seismic event when water chiller base is anchored to field support structure.
- D. Corrosion Protection: The entire unit, including the base, frame, casing, evaporator, condenser, compressors, refrigerant piping, fans, etc. shall be corrosion protected with a corrosion inhibitor such as Adsil or an approved substitution.
- E. Refrigerant Circuits: The chiller shall have a minimum of two (2) independent and complete refrigerant circuits.
- F. Cabinet:
 1. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
 2. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.
 3. Casing: Galvanized steel.
 4. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B 117.
 5. Sound-reduction package consisting of the following:

- a. Acoustic enclosure around compressors.
 - b. Reduced-speed fans with acoustic treatment.
 - c. Designed to reduce sound level without affecting performance.
 6. Security Package: Provide security grilles with fasteners for additional protection of compressors, evaporator, and condenser coils. Grilles shall be coated for corrosion resistance and shall be removable for service access.
- G. Compressors:
1. Description: Positive-displacement direct drive with hermetically sealed casing.
 2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
 3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
 4. Capacity Control: On-off compressor cycling, plus hot-gas bypass.
 5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.
 6. Vibration Isolation: Mount individual compressors on vibration isolators.
- H. Compressor Motors:
1. Hermetically sealed and cooled by refrigerant suction gas.
 2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.
- I. Compressor Motor Controllers:
1. Across the Line: NEMA ICS 2, Class A, full voltage, non-reversing.
- J. Refrigeration:
1. Refrigerant: R-410a. Classified as Safety Group A1 according to ASHRAE 34.
 2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
 3. Refrigerant Circuit: Each circuit shall include a thermostatic expansion valve with a replaceable thermostatic element, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
 4. Refrigerant Isolation: Factory installed positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.
- K. Evaporator:
1. Brazed-plate design, as indicated.
 2. Brazed Plate:
 - a. Direct-expansion, single-pass, brazed-plate design.
 - b. Type 316 stainless-steel construction.

- c. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
 - d. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping.
- 3. Heater: Factory-installed and -wired electric heater with integral controls or self-regulating type designed to protect the evaporator to minus 20 deg F.
- 4. Remote Mounting: Designed for remote field mounting where indicated. Provide kit for field installation.

L. Air-Cooled Condenser:

- 1. Plate-fin coil with integral sub-cooling on each circuit, rated at 450 psig. Coil shall be tested under water to 450 psig.
 - a. Construct coils of copper tubes mechanically bonded to aluminum plate fins.
 - b. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
- 2. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
- 3. Fan Motors: Totally enclosed non-ventilating (TENV) or totally enclosed air over (TEAO) enclosure, with permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.
- 4. Fan Guards: Steel safety guards with corrosion-resistant coating.

M. Electrical Power:

- 1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.
- 2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.
- 3. Wiring shall be numbered and color-coded to match wiring diagram.
- 4. Install factory wiring outside of an enclosure in a raceway.
- 5. Field power interface shall be to a NEMA KS 1, heavy-duty, non-fused disconnect switch.
- 6. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:
 - a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - b. NEMA KS 1, heavy-duty, non-fusible switch.
 - c. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- 7. Provide each motor with overcurrent protection.
- 8. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
- 9. Phase-Failure and Under-voltage: Solid-state sensing with adjustable settings.

10. Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
 - a. Power unit-mounted controls where indicated.
 - b. Power unit-mounted, ground fault interrupt (GFI) duplex receptacle.
11. Control Relays: Auxiliary and adjustable time-delay relays.
12. Indicate the following for water chiller electrical power supply:
 - a. Current, phase to phase, for all three phases.
 - b. Voltage, phase to phase and phase to neutral for all three phases.
 - c. Three-phase real power (kilowatts).
 - d. Three-phase reactive power (kilovolt amperes reactive).
 - e. Power factor.
 - f. Running log of total power versus time (kilowatt hours).
 - g. Fault log, with time and date of each.
13. Provide a factory mounted and wired surge suppression device (SPD) for the chiller. The SPD shall be mounted inside the casing of the chiller. The SPD shall be in accordance with the Section 26 43 13 - TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS.

N. Controls:

1. Stand-alone, microprocessor based.
2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
3. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes. Display the following:
 - a. Date and time.
 - b. Operating or alarm status.
 - c. Operating hours.
 - d. Outside-air temperature if required for chilled-water reset.
 - e. Temperature and pressure of operating set points.
 - f. Entering and leaving temperatures of chilled water.
 - g. Refrigerant pressures in evaporator and condenser.
 - h. Saturation temperature in evaporator and condenser.
 - i. No cooling load condition.
 - j. Elapsed time meter (compressor run status).
 - k. Pump status.
 - l. Anti-recycling timer status.
 - m. Percent of maximum motor amperage.
 - n. Current-limit set point.
 - o. Number of compressor starts.
4. Control Functions:
 - a. Manual or automatic startup and shutdown time schedule.

- b. Entering and leaving chilled-water temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on return-water temperature.
 - c. Current limit and demand limit.
 - d. External water chiller emergency stop.
 - e. Anti-recycling timer.
 - f. Automatic lead-lag switching.
- 5. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:
 - a. Low evaporator pressure or high condenser pressure.
 - b. Low chilled-water temperature.
 - c. Refrigerant high pressure.
 - d. High or low oil pressure.
 - e. High oil temperature.
 - f. Loss of chilled-water flow.
 - g. Control device failure.
- 6. Building Automation System (BAS) Interface: Factory-installed hardware and software shall enable the BAS to monitor, control, and display water chiller status and alarms.
 - a. Hardwired Points:
 - 1) Monitoring: On/off control, status, common trouble alarm, entering and leaving chilled water temperatures and runtime.
 - 2) Control: On/off operation, chilled-water discharge temperature set-point adjustment, head pressure control down to -20 degrees F.
 - b. The new chiller shall communicate with the existing BAS. The existing BAS is a TAC INET Seven. The existing chiller presently communicates with the TAC system and the points specified above are also existing points. The contractor shall provide any necessary hardware or software to interface the new chiller with the TAC INET Seven.

O. Insulation:

- 1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials.
- 2. Thickness: 1-1/2 inches.
- 3. Factory-applied insulation over cold surfaces of all water chiller components.
 - a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.
- 4. Apply protective coating to exposed surfaces of insulation.

P. Accessories:

- 1. Factory-furnished, chilled-water flow switches for field installation.

2. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigeration circuit.
3. Factory-furnished neoprene isolators for field installation.
4. Heat tracing on evaporator and external piping down to -20 degrees F.

Q. Capacities and Characteristics:

1. Refer to paragraph 1.3B. above for capacities and characteristics.

2.2 SOURCE QUALITY CONTROL

- A. Perform functional test of water chillers before shipping.
- B. Factory performance test water chillers, before shipping, according to ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."
 1. Allow COTR access to place where water chillers are being tested. Notify COTR 7days in advance of testing.
- C. Factory test and inspect evaporator and water-cooled condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.
- D. For water chillers to be located outdoors, rate sound power level according to ARI 370 procedure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before water chiller installation, examine rough-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.
 1. Water chiller locations indicated on the Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

- A. Install water chillers on the existing concrete pad as indicated.
- B. Equipment Mounting: Install water chiller on the concrete pad using elastomeric pads.
- C. Maintain manufacturer's recommended clearances for service and maintenance.
- D. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.

- E. Install separate devices furnished by manufacturer and not factory installed.

3.3 CONNECTIONS

- A. Comply with requirements in Section 23 21 13 "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to chiller to allow service and maintenance.
- C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, and drain connection with valve. Make connections to water chiller with a union.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
- C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
 - 2. Verify that thermometers and gages are installed.
 - 3. Operate water chiller for run-in period.
 - 4. Check bearing lubrication and oil levels.
 - 5. Verify proper motor rotation.
 - 6. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
 - 7. Verify and record performance of chilled water flow and low-temperature interlocks.
 - 8. Verify and record performance of water chiller protection devices.
 - 9. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- D. Prepare a written startup report that records results of tests and inspections.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train FAA's maintenance personnel to adjust, operate, and maintain water chillers. Video record the training sessions.

END OF SECTION 23 64 23

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 Wire, Conduit and Switches

- A. Items not shown in detail or covered by detailed specifications shall be as set forth in the National Electrical Code.
- B. Conduit And Fittings: All conduit located inside the building shall be electric metallic tubing (EMT) with compression ring type fittings. EMT is permitted above 8 feet or in protected spaces such as shafts only. All other should be RGS. All conduit located outside the building shall be rigid steel with threaded fittings. Conduit below ground shall be rigid steel with a factory applied plastic coating. Flexible conduit, both inside and outside, shall be metallic. Flexible conduit located outside shall be liquid tight. Flex conduit shall be used for equipment whips only and shall be limited to 6 feet maximum.
- C. Conduits shall be installed parallel or at right angles to the building lines. Conduits shall be securely supported and fastened in place at intervals of not more than 5 feet and at each change in direction. Support the conduit from building structural steel, walls, or other R.E. approved structural components. Fasteners shall be conduit hangers or one-hole malleable iron pipe straps with appropriate screws or bolts for the surface material. Conduits shall not be supported from metal roof decking. Suspended ceiling support wires shall not be used for the support of conduits. Changes in direction shall be symmetrical bends or cast-metal fittings. Each conduit entrance to outlet boxes, panel boards, and equipment cabinets shall be fitted with a lock nut and insulated throat connector.

- 1.2 Wire: All wire shall have copper conductors. Size shall be American Wire Gauge (AWG) with size for power circuits, but not smaller than #12 AWG. Size for all control circuit wiring shall be #16 AWG. Power wire #10 AWG and smaller shall be solid; #8 and larger wire, and all control wire, shall be stranded. Insulation shall be type THW or THWN for power wire and type MTW for control wire and shall be color coded as follows:

<u>Single Phase</u>		<u>Three Phase</u>	
<u>120 Volts</u>	<u>208/240 Volts</u>	<u>120/208 or 240 Volts</u>	<u>277/480 Volts</u>
Line-Black	Line 1-Black	Phase A-Black	Phase A-Yellow
Neutral-White	Line 2-Red	Phase B-Red	Phase B-Brown
	Neutral-White	Phase C-Blue	Phase C-Orange
		Neutral-White	Neutral-White

All Circuits:

Ground	Green
Control	Black with numbered adhesive markers on both ends or multi-conductor with unique continuous color coded insulation.

- 1.3 Power wires #8 and smaller shall have continuous colored insulation. Wires #6 and larger may utilize continuous colored insulation or colored tape. Where conductors are color coded with tape, they shall be half lapped for a minimum length of 3 inches in all junction and pull boxes, accessible raceways, panel boards, outlets, switches and equipment cabinets.
- 1.4 All wire shall be continuous; no splices will be permitted unless otherwise specified. Where permitted, splices shall be accomplished with compression type connectors bonded to the wire with a crimping tool and procedure approved by the connector manufacturer.
- 1.5 Wires shall not be installed until all conduit and fittings are in place. All wires shall be drawn into conduit simultaneously and with adequate lubricating compound to prevent damage to insulation.
- 1.6 Control wiring installed within control panels shall be neatly routed between the control components and shall run parallel and perpendicular to the sides of the panel. Wires which run diagonally from component to component will not be acceptable. Wiring shall have sufficient slack to prevent tension on the termination connector. Route wires between components in the most direct path possible without overshoots and loop-backs. Wires shall be run in open slot wiring duct (Thomas & Betts model 91XXX, or an approved substitution with size as required for application.) or bundles of wires shall be neatly secured with nylon self-locking cable ties. Terminate all control wires with spade type, crimped terminals; Exception: Devices such as relays and terminal blocks which utilize clamp type terminals will not be required to have crimped terminals on the wire. Wrapping of wires around screw heads will not be acceptable. All wires exiting the control panel shall terminate on a screw terminal block with each terminal marked the same as on the control schematic on the project drawings.
- 1.7 Grounding: All non-current carrying metallic parts of the electrical system shall be grounded with an insulated wire sized and installed in accordance with Article 250 of the National Electrical Code. Ground wire shall be connected to ground bus in each power panel, to ground lug on receptacles, and to enclosure or frame of major electrical devices such as safety switches, motors, motor starters, terminal cabinets, light fixtures, etc. Connection of wire to these devices shall be with a separate machine screw and nut which bonds to a clean, bare metal surface. Self tapping screws are not acceptable for this purpose. Screws which are used for support of the enclosure shall not be used for this purpose. Use full size neutrals for every OPD.
- 1.8 Safety Switches: Safety switches shall be NEMA rated as heavy duty. Enclosures shall be NEMA type 1 in indoor locations and NEMA type 3R in outdoor or damp locations to be a different type for the specific application. Switches shall be of the number of poles, voltage and amperage ratings shown on the project drawings. Furnish fuse clips to receive cartridge type dual element fuses in all poles if fusible switches are required on the project drawings. Switches shall be the quick-make, quick-break type with visible blades. Switch handles shall be the extended arm type for easy identification of position. Switches which utilize rocker arm

type handles or have concealed blades are not acceptable. Switch handles shall be capable of being secured in both the on and off positions by use of a Government owned and installed padlock with a 5/16" diameter shackle. The switch cover shall also be capable of being secured in the closed position with a separate Government owned and installed padlock with a 5/16" diameter shackle. The Contractor shall modify the switch as required to achieve these locking capabilities. The switch shall be grounded with a separate grounding bushing secured to the enclosure's bare metal with a bolt and nut. The use of the neutral bus inside the switch with, or without, a grounding electrode screw bonded to the enclosure will not be allowed as a satisfactory enclosure ground. A brand name safety switch known to meet the salient characteristics of this specification is Square D, Class 3110, Heavy Duty. Label the switch with an engraved laminated plastic plate. The label shall have the voltage, phase, source, i.e. panel number and breaker number, and duty, i.e. what the switch serves.

1.9 SUMMARY

- A. Materials and equipment shall comply with all requirements of the contract documents. Materials furnished by the Contractor shall be new, the standard products of manufacturers regularly engaged in the production of such materials, and of the manufacturer's latest designs that comply with the specification requirements.
- B. If material and equipment requirements conflict, the order of precedence for selection shall be as follows: special contract provision, this specification, the contract drawings; and then in continuing order of precedence, military specifications, federal specifications, NFPA publications, IEEE standards, UL standards and NEMA standards. Wherever standards have been established by Underwriters Laboratories, Inc., the material shall bear the UL label.

1.10 REFERENCES

A. FAA Orders and Standards:

- 1. FAA-STD-1217f, Electrical Work, Interior
- 2. FAA-STD-1391B Installation and Splicing of Underground Cables
- 3. FAA-STD-019e, Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Electronic Equipment

B. National Fire Protection Association (NFPA)

- 1. NFPA 70, National Electrical Code.
- 2. NFPA 110 Standard for Emergency and Standby Power Systems

C. Institute of Electrical and Electronic Engineers (IEEE)

- 1. IEEE C2 National Electrical Safety Code
- 2. IEEE Std 100 Dictionary of Electrical and Electronics Terms

D. National Electrical Manufacturers Association (NEMA)

- 1. NEMA C57.12.28 Pad-Mounted Equipment - Enclosure Integrity

- | | | |
|----|------------|---|
| 2. | NEMA ICS 6 | Industrial Control and Systems Enclosures |
| 3. | NEMA MG 1 | Motors and Generators |
| 4. | NEMA MG 10 | Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors |
| 5. | NEMA MG 11 | Energy Management Guide for Selection and Use of Single-Phase Motors |

1.11 SEQUENCING AND SCHEDULING

A. Coordinate electrical equipment installation with other building components.

1. Arrange for chases, slots and openings in building structure during progress of construction to allow for electrical installations.
2. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
3. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the work. Coordinate installing large equipment requiring positioning prior to closing in the building.
4. Coordinate connecting electrical service to components furnished under other Sections.
5. Coordinate connecting electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
6. Coordinate requirements for access panels and doors where electrical items requiring access are concealed by finished surfaces.
7. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.
8. Coordinate installing electrical identifying devices and markings prior to installing acoustical ceilings and similar finishes that conceal such items.

B. Interruption of Power:

1. Contractor is advised that the project site is located at a fully operational airport. Unscheduled power interruptions to any of the electrical distribution systems is not allowed. Work requiring a temporary or permanent de-energizing of the electrical service shall be scheduled and approved in writing by the Contracting Officer's Technical Representative at least 14 calendar days in advance of performance of the work. Work may not commence until written authorization is received from the Contracting Officer's Technical Representative.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION

- A. Manufacturer's Nameplate: Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. All materials and equipment shall be installed in accordance with the contract drawings. Where manufacturer's recommended installation methods conflict with the contract requirements, difference shall be resolved by the Contracting Officer's Technical Representative. The installation shall be accomplished by skilled workers regularly engaged in this type of work. Where required by local regulation, the workers shall be properly licensed. Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated. Install items level, plumb, and parallel and perpendicular to other building systems and components, except where otherwise indicated. Install equipment to facilitate service, maintenance and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations. Give right of way to raceways and piping systems installed at a required slope.

3.2 INSTALLATION

- A. The rules, regulations, and reference documents indicated shall be considered as minimum requirements and shall not relieve the Contractor from furnishing and installing higher grades of materials and workmanship than are specified or when required by the contract drawings. Equipment shall be installed in a manner to provide proper working space, access, and space for removal of the equipment to suit intended application.
- B. Contract Requirements:
 - 1. Furnish and install equipment, material and labor for a complete and proper installation. Ensure that electrical and communications work is coordinated and compatible with Architectural, Mechanical, Structural, and Civil work.
- C. Fire Stopping:
 - 1. Apply to cable and raceway penetrations of fire-rated floor and wall assemblies. Perform fire stopping to re-establish the original fire resistance rating of the assembly at the penetration.
- D. Wiring Methods:

1. All wiring shall consist of insulated copper conductors installed in metallic raceways, unless otherwise specified.
 - E. Conductor Routing:
 1. Panel boards, surge arresters, disconnect switches, etc., shall not be used as a raceway for conductor routing other than conductors that originate or terminate in these enclosures. Isolated ground conductors will be allowed to traverse these enclosures.
 - F. Conductor Separation:
 1. Power conductors shall be routed separately from all other conductor types. Route power conductors and other conductors in separate raceways, or by a metallic divider between the power conductors and the other conductors in the same raceway. 480Y/277V power cables shall be in separate raceways from 208Y/120V power cables.
 - G. Neutral Conductor:
 1. Shared/common neutrals shall not be permitted (i.e., each overcurrent device shall have its own separate neutral conductor). Neutral conductor sizes shall not be less than the respective feeder or phase conductor sizes.
 - H. Ground Conductor:
 1. Shared/common grounding conductors shall not be permitted (i.e., each overcurrent protective device shall have its own separate ground conductor). The equipment grounding conductor shall be installed in the same conduit as its related branch and feeder conductors and shall be connected to the ground bus in the branch or distribution panelboard. Equipment ground conductor shall be the same size as the phase conductors were indicated for special equipment branch or feeder circuits that require parity sized ground conductors to comply with equipment manufacturer's recommendations.
 - I. Separation:
 1. Where power and control cables share the same manhole, they shall be installed on opposite sides of the manhole. The entire exposed length of control, telephone and signal cables shall be fireproofed by applying a 1/4-inch minimum thickness of arc-proofing. Known acceptable source is 3M No. 7700 or approved equal.
 - J. Cable Terminations:
 1. Provide terminations in accordance with this Section and manufacturer's requirements. All splices (including those in the building) must be approved by the Contracting Officer's Technical Representative.
- 3.3 DEMOLITION
- A. Protect existing electrical equipment and installations when performing new work. If damaged or disturbed in the course of the work, remove damaged portions and install new products of equal capacity, quality, and functionality. Remove demolished material from the project site.

Remove, store, clean, re-install, reconnect, and make operational components indicated for relocation.

B. Accessible Work:

1. Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work:

1. Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish. All wire not removed shall have the Contracting Officer's Technical Representative's written approval.

3.4 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved. Repair disturbed surfaces to match adjacent undisturbed surfaces.

3.5 FIELD TESTING

- A. Perform tests necessary to establish the adequacy, quality, safety, completed status, and suitable operation of each system. Repair or replace equipment that does not meet test requirements and retest. Tests shall be scheduled and approved in writing by COTR at least 21 calendar days prior to conducting tests. Unless otherwise indicated, the Contractor shall furnish all test instruments, materials, and labor necessary to perform tests designated in Division 26 Sections. All tests shall be performed in the presence of the Contracting Officer's Technical Representative. All instruments shall have been calibrated within a period of 1 year preceding testing. Calibrations shall be traceable to applicable industry recognized standards.

END OF SECTION 26 05 00

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SECTION 26 43 13 - TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL
POWER CIRCUITS

PART 1 - GENERAL

1.1 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications listed below are referenced as the latest edition published as of the date of this document. The publications are referred to within the text by the basic designation only.

1. American National Standards Institute/ Institute of Electrical and Electronics Engineers/(ANSI/IEEE)
 - a. C62.41 Guide for Surge Voltages in Low Voltage AC Power Circuits
 - b. C62.45 Standard for Testing Procedures and Practices
2. FAA Specifications and Standards
 - a. FAA-STD-19e Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities
3. National Electrical Manufacturers Association (NEMA)
 - a. NEMA LS1 Low Voltage Surge Protective Devices
4. National Fire Protection Association (NFPA)
 - a. NFPA 70 National Electrical Code
5. Occupational Safety and Health Administration (OSHA)
 - a. 29 CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)
6. Underwriters Laboratories (UL)
 - a. UL 1283 Electromagnetic Interference Filters
 - b. UL 1449 Transient Voltage Surge Suppressors
 - c. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
 - d. UL 67 Panelboards

1.2 SUMMARY

This Section includes transient voltage surge suppressors for low-voltage circuits and equipment. Switchgear, panelboard and motor control center mounted suppressors are included.

- A. Transient Voltage Surge Suppressors (TVSS): Surge protection of AC electrical circuits and systems from the effects of lightning induced currents/voltages, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching and radio frequency/electromagnetic interference. Suppression protection for building service entrance as indicated on drawings. Surge protection for all circuits sensing, powering, and controlling devices located or mounted external to the building. The unit shall provide effective high-energy transient voltage suppression, surge current diversion, high-frequency electrical line noise attenuation, and line control in C62.41 environments.
- B. Incoming Secondary Electrical Service: The incoming secondary electrical service entrance conductors shall terminate at the main secondary switchgear's MCB and it shall be protected with a class C3 transient voltage surge suppressor (TVSS)/surge protection device (SPD). The TVSS/SPD device(s) shall be installed as close as possible to the service entrance overcurrent protection device (OCPD) they serve and in accordance with the manufacturer's instructions. All essential power and critical power panelboards and all panelboards supplying exterior circuits such as obstruction lights, exterior convenience outlets, guard shacks, electrical gates, and feeds to other facilities shall be protected by a Class C3 TVSS/SPD installed as close as possible to the panelboard they serve and in accordance with the manufacturer's instructions. Downstream normal utility panelboards as indicated on the drawings shall be protected by a Class B TVSS/SPD installed as close as possible to the panelboards they serve and in accordance with the manufacturer's instructions.
- C. National Airspace System (NAS) Facilities: Surge protective devices shall be installed on all critical and essential panels providing service to NAS operational equipment or supplying exterior circuits. SPDs shall be selected in accordance with the guidance provided in C62.41 and meet the requirements of UL 1449. Devices for panels serving exterior circuits shall be tested for a level C3 application per C62.41. The conduit or conduit nipple connecting the SPD enclosure to the panel enclosure shall be sealed with duct seal or other nonflammable medium to prevent soot from entering the enclosure in the event of SPD failure. The use of potting material in SPDs is strictly prohibited. All SPD components must be accessible for inspection by qualified FAA personnel. The maximum (MCOV) for SPDs located at branch and distribution panels shall be equal to or greater than the maximum (MCOV) of those located at the facility service.
- D. Electronic Equipment Power Lines: Surge protection devices, components or circuits for protection of electronic equipment power lines shall be provided as an integral part of all electronic equipment. These devices shall be positioned at the AC power conductor entrance to electronic equipment provided as part of the facility. Transient protection shall be provided on all combinations of L-L, L-G, L-N and N-G. SPDs at equipment shall provide a clamping level less than the equipment susceptibility level. Electronic equipment that is to be installed outside of facilities shall also require protection to the level supplied for the facility. Electronic equipment, such as radars, nav aids, transmitters supplied as part of the facility, shall be provided with transient protection that shall reduce surges and transients of 2.5 times the normal operating voltage of 600 volts whichever is larger, to below the equipment susceptibility level. The equipment susceptibility level is defined as the transient level on the signal, control or data line that may cause damage, degradation, or upset to electric circuitry connected to the line. The electronic equipment manufacturer shall perform tests to determine the voltage, current or energy levels that will cause immediate damage to components, shorten its operating life or cause operational upset. These tests shall consider all electrical and electronic equipment components exposed to the effects or surges or transients. The combined facility and equipment

entrance protection shall be coordinated to limit transients at the equipment to below the equipment susceptibility level. In all cases the following characteristics shall be evaluated.

1. Component damage threshold. The damage thresholds is the transient level that renders the component nonfunctional or operationally deficient. For solid-state components, voltage is usually the relevant parameter.
 2. Component degradation level is the transient voltage or energy level that shortens the useful life of the component.
- E. Operational Upset Level: The operational upset level is the transient voltage or energy level that causes an unacceptable change in operating characteristics for longer than 10 milliseconds for analog equipment or a change of logic state for digital equipment.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00, "SUBMITTAL PROCEDURES."

A. Shop Drawings

1. Electrical One-Line Diagram
2. Show locations of each unit installation point.
3. Wiring Diagrams
4. Elementary or schematic. Single-line diagram of TVSS showing connections between TVSS power source and load plus any interlocking provisions, operation and maintenance data.

B. Product Data

1. Each suppressor category type
2. Submit product descriptions indicating dimensions for each suppressor type and mounting arrangement with required hardware conductor.

C. Test Reports

1. UL certified test data
2. Provide third party testing documentation demonstrating that the device will survive the published maximum surge current rating. Test reports will clearly show that the tests were performed on a COMPLETE device including all necessary fuses, thermal disconnects and monitoring systems.
3. Provide data demonstrating that the device is capable of surviving the specified number of C62.41 Category C3 (10kA) impulses without failure or performance degradation of more than 10 percent.
4. Provide UL 1449 reports as certified by UL. The report shall also include any "Engineering Considerations".
5. Provide a COMPLETE test package per the requirements of NEMA LS1.
6. Field Test Reports
7. Indicate and interpret results for compliance with performance requirements.

D. Operation and Maintenance Data

1. Transient Voltage Surge Suppressors

E. Closeout Submittals

1. Warranties
2. Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Perform work to meet or exceed the requirements of NFPA 70 and other applicable statutes, ordinances, codes and regulations of Government authorities having jurisdiction. Notify the Contracting Officer's Technical Representative of known or probable code violations discovered during subcontractor performance. Do not proceed with the work until violations have been resolved.
- B. Listed and Labeled: Provide electrically operated equipment specified in this Section that is listed and labeled. The terms "listed" and "labeled" as defined in NFPA 70, Article 100.
- C. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory as defined in 29 CFR 1910.7.
- D. Manufacturer's Qualifications: Surge suppression devices manufactured by a company engaged in the design, development, and manufacture of surge suppression devices for the protection of electrical circuits and electronic equipment with such products in satisfactory use in similar service for not less than 5 years.
- E. Regulatory Requirements: For the purposes of this Specification, IEEE Category C and B locations, shall assume a maximum voltage amplitude of 20 kilovolts and a maximum current amplitude to 10 kiloamperes. Comply with UL 1449.

1.5 WARRANTY

- A. Special Warranty: Special warranties specified in this Article shall not deprive the FAA of other right FAA may have under other provisions of the contract documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the contract documents.
- B. General Warranty: A written warranty, executed by manufacturer, agreeing to repair or replace components of transient voltage surge suppressors that fail in materials or workmanship within the specified period. Warranty period shall be 5 years from date of final acceptance by the FAA. Should suppressors be destroyed by surge(s) or transients, free replacement shall apply during the warranty period.

1.6 MAINTENANCE

- A. Surge suppressor manufacturer shall provide replacement unit or factory certified service and repair for surge suppressor units within 24 hours from time of notification.

2.1 SUPPRESSOR CRITERIA-SERVICE ENTRANCE SWITCHGEAR, AND PANELBOARDS SERVING EXTERIOR OR ESSENTIAL BUILDING LOADS

- A. Suppressors shall utilize solid-state components that operate bi-directionally. The suppressor shall be factory-mounted in the device by the equipment manufacturer. Provide integral disconnecting means with current limiting fuses and a surge counter integral to the TVSS. The UL 1449 clamping voltages listed below includes the phase fuses.
- B. Service Entrance Suppressor: As defined in C62.41, Category 3.
- C. Three-Phase, Three-Wire Configuration: Provide independent suppression elements connected line-to-ground (L-G) and line-to-line (L-L).
- D. Three-Phase, Four-Wire Configuration: Provide independent suppression elements connected line-to-ground (L-G), line-to-neutral (L-N), and neutral-to-ground (N-G).
- E. Metal Oxide Varistors (MOVs): Use as suppression elements, each individual MOV must be rated for a minimum of 115 percent of nominal operating voltage.
- F. Turn-On/Turn-Off Times: Suppressors shall have turn-on and turn-off times of less than 1-nanosecond for each element, less than 5 nanoseconds for each system.
- G. 480 Volt Delta Connected Suppressor Criteria: Line-to-line and line-to-ground maximum single impulse current rating of 160,000 amps (8 x 20 microsecond waveform). Pulse life rating of 10,000 amperes (8 x 20 microsecond waveform) with 1,500 occurrences in accordance with FAA-STD-19e. Maximum clamping voltage and current rating when subjected to waveform with 1.2 by 50 microsecond, 20kV open circuit voltage and 8.0 by 20 microsecond, 10kA short circuit current.

480 volts

1,500 volts

- H. 480Y/277 Volt Wye Connected Suppressor Criteria: Line-to-neutral maximum single impulse current rating of 160,000 amps (8 x 20 microsecond waveform). Line-to-ground maximum single impulse current rating of 160,000 amps (8 x 20 microsecond waveform). Neutral-to-ground maximum single impulse current rating of 160,000 amps (8 x 20 microsecond waveform). Pulse life rating of 10,000 amperes (8 x 20 microsecond waveform) with 1,500 occurrences in accordance with FAA-STD-19e. Maximum clamping voltage and current rating when subjected to waveform with 1.2 by 50 microsecond, 20kV open circuit voltage and 8.0 20 microsecond, 10kA short circuit current.

SYSTEM VOLTAGE WYE CONNECTED CLAMPING VOLTAGES

L - N	L - G	N - G
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480Y/277 Volts	900V	900V	900V
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- I. 208Y/120 Volt Wye Connected Suppressor Criteria: Line-to-neutral maximum single impulse current rating of 160,000 amps (8 x 20 microsecond waveform). Line-to-ground maximum single impulse current rating of 160,000 amps (8 x 20 microsecond waveform). Neutral-to-ground maximum single impulse rating of 160,000 amps (8 x 20 microsecond waveform). Pulse life rating of 10,000 amperes (8 x 20 microsecond waveform) with 1,500 occurrences in accordance with FAA-STD-19e. Maximum clamping voltage and current rating when subjected to a waveform with 1.2 by 50 microsecond, 6kV open circuit voltage, and 8.0 by 20 microsecond, 3kA short circuit current.

SYSTEM VOLTAGE WYE CONNECTED	CLAMPING VOLTAGES		
	L - N	L - G	N - G
208Y/120 Volts	400V	400V	400V

- J. Indication of Proper Connection and Operation: Provide visible indication of proper suppressor connection and operation without having to disconnect or disassemble the unit.
- K. Mounting Position: The mounting position of the suppressor shall permit a direct bus bar connection between the suppressor and the point of connection to the assembly bus.
- L. Panelboards: In addition to complying with all the requirements of Section 26 24 17, "Panelboards (GFE)", shall be provided with 200 percent rated neutral; isolated ground bus; and UL 67 and UL 1449 system labels.

2.2 SUPPRESSOR CRITERIA-PANELBOARDS SERVING INTERIOR NON-ESSENTIAL BUILDING LOADS

- A. Suppressors shall utilize solid-state components that operate bi-directionally. Provide a surge counter integral to the TVSS.
- B. Panelboard Location: Defined as branch circuit panel locations in accordance with C62.41, Category B3, unless otherwise shown on the drawings.
- C. Three-Phase, Four-Wire Configuration: Provide independent suppression elements connected line-to-ground (L-G), line-to-neutral (L-N), and neutral-to-ground (N-G).
- D. Metal Oxide Varistors (MOVs): If metal oxide varistors are used as suppression elements, each individual MOV must be rated for a minimum of 115 percent of nominal operating voltage.
- E. Turn-on/Turn-off Times: Suppressors shall have turn-on and turn-off times of less than 1-nanosecond for each element, less than 5 nanoseconds for each system.
- F. 100,000 Ampere Surge Current Per Phase Criteria: Line-to-neutral maximum single impulse current rating of 50,000 amps (8 x 20 microsecond waveform). Line-to-ground maximum single impulse current rating of 50,000 amps (8 x 20 microsecond waveform). Neutral-to-ground maximum single impulse rating of 50,000 amps (8 x 20 microsecond waveform). Pulse life rating of 10,000 amps (8 x 20 microsecond waveform) with 6,000 occurrences in accordance with C62.45. Maximum clamping voltage and current rating when subjected to a

waveform with 1.2 by 50 microsecond, 6kV open circuit voltage, and 8.0 by 20 microsecond, 3kA short circuit current.

SYSTEM VOLTAGE WYE CONNECTED	CLAMPING VOLTAGES		
	L - N	L - G	N - G
208Y/120 Volts	400V	400V	400V

2.3 FILTERING

- A. Electromagnetic interference and radio frequency filters shall be provided per UL 1283 and UL 1449 for all suppressors. The filtering circuit shall provide a minimum insertion loss as indicated below. Note: Standardized insertion loss data obtained utilizing MIL-STD-220A 50 ohm insertion loss methodology.

<u>Frequency</u>	<u>100 KHZ</u>	<u>1 MHZ</u>	<u>10 MHZ</u>	<u>100 MHZ</u>
Attenuation (dB)	34	51	54	48
Attenuation Ratio	50:1	350:1	500:1	250:1

2.4 ANNUNCIATION (COVER-MOUNTED)

- A. Service Entrance Switchgear: Provide diagnostic and monitor panel. Provide visual status indicators, one for each suppression module. Provide one normally open and one normally closed dry contacts interlocked with status alarm monitoring. Component failure shall be detected by infrared detection and alarmed. Component thermal detection system. Provide a transient counter.
- B. Distribution Panels and Panelboard: Provide visual status indicators, one for each suppression module. Provide a transient counter.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances, power characteristics, and other conditions affecting performance of transient voltage surge suppressors. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate installation of TVSS system with manufacturers and suppliers of equipment to be protected. Demonstrate and train FAA authorized personnel for service and operation of the systems.

3.3 CONNECTIONS

- A. Ground each transient voltage surge suppressor enclosure. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.4 FIELD QUALITY CONTROL

- A. The Contractor shall have a representative on site during the FAA's acceptance testing and demonstration of this equipment to witness the proceedings.

END OF SECTION 26 43 13